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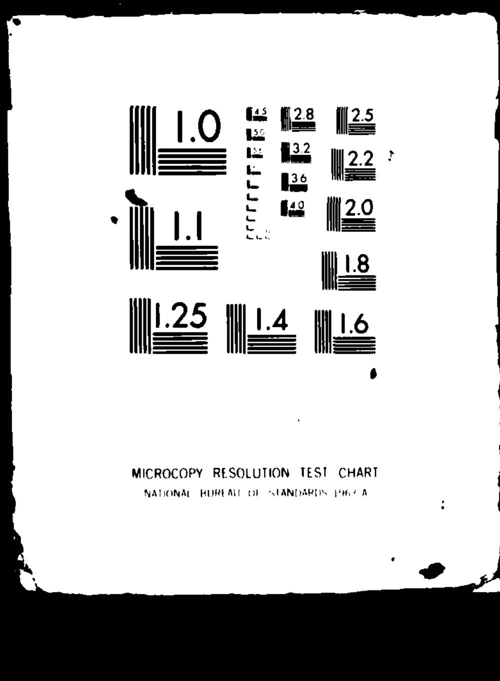

Report No. FAA-CT-81-38
FAA-EM-81-4

LEVEL II

13

THE EFFECTS OF PILOT EXPERIENCE ON ACQUIRING INSTRUMENT FLIGHT SKILLS

PHASE I

Embry-Riddle Aeronautical University
Regional Airport, Daytona Beach, Florida

Seville Research Corporation
Pensacola, Florida

FINAL REPORT

MARCH 1981

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Prepared for

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Technical Center
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Office of Systems Engineering Management
Washington, D.C. 20591

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16. Abstract

NTSB accident data indicate that low-time, non-instrument rated general aviation pilots are disproportionately involved in fatal weather-related accidents. In view of the existing 200-hour experience requirement (FAR 61.65) for an instrument rating, some 150 hours of flight time must be accumulated between Private Pilot Certification and issuance of the rating. During this period there is a fairly high probability of encountering weather conditions that present task demands which exceed the capabilities of the pilot. Suggestions have been made to reduce the 200-hour requirement in the hope that earlier instrument training would be sought, thereby reducing these accidents.

The study reported here examined the relationship of pilot experience to the acquisition of instrument flight skills. Seventy-nine Embry-Riddle Aeronautical University students were assigned to one of three experimental training groups in which a full program of private, instrument, and commercial pilot training was administered. Prior to taking their instrument checkrides, the groups had 113, 138, and 171 mean hours of flight time, respectively. Inflight performance was assessed objectively and subjectively. No statistically significant differences were found among tracks in instrument flying skill.

Results suggest that a reduction in the 200-hour experience requirement should be considered. Such a reduction would encourage earlier training of instrument skills and could reduce the weather-related accident rate for low-time private pilots.

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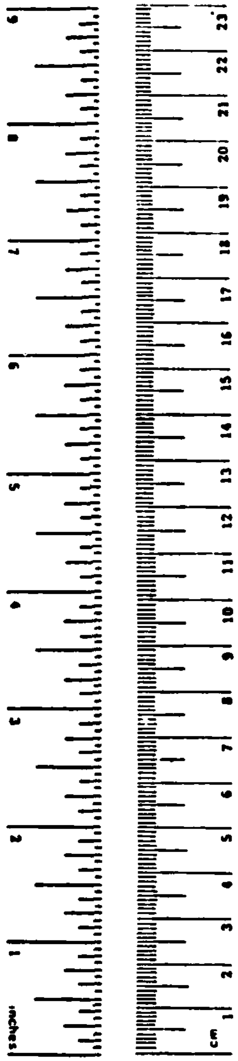
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

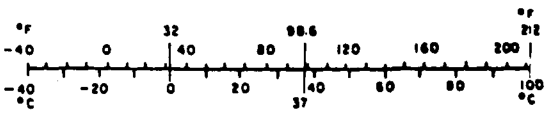
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



EXECUTIVE SUMMARY

One of the most important considerations in the attempt to improve general aviation safety is the necessity for general aviation pilots to operate in a wide range of degraded weather conditions. A review of National Transportation Safety Board (NTSB) weather-related accident data indicates that such conditions are significant factors in general aviation pilot safety and efficiency. A disproportionate number of fatal and non-fatal weather-related accidents have involved pilots with fewer than 200 hours of total time and little or no instrument training.

Because of the relatively high rate of involvement of low time, non-instrument rated pilots in weather-related accidents, there is a growing concern that a training problem exists relative to current FAA instrument rating requirements. For example, many non-instrument rated private pilots delay commencing instrument training until they have accumulated some 150-160 hours of flight time. An unfortunate consequence of this practice is that because these pilots do not actively pursue the instrument rating prior to the 150 hour level, they do not acquire the instrument flying skills necessary to operate safely within the variety of degraded weather conditions that many of them encounter either deliberately or nondeliberately. It is such encounters that often comprise "continued VFR operations in IFR conditions" as a causal or contributing factor in weather-related accidents. Therefore, a practical and empirical question has been raised concerning the advisability of reducing the 200-hour total flight time requirement for obtaining the instrument rating. In view of these considerations an experimental investigation was conducted to gather information relevant to this question. The experiment was carried out jointly by Embry-Riddle Aeronautical University (E-RAU), Daytona Beach, Florida, and the Seville Research Corporation, Pensacola, Florida. The effort was sponsored by the Federal Aviation Administration (FAA) Technical Center and the FAA Office of Systems Engineering Management, and was monitored by the FAA Office of Flight Operations.

OBJECTIVES.

The primary objective of the experiment reported here was to examine the relationship of pilot experience, as defined by total flight time, to the acquisition of instrument flight skills as demonstrated by performance on the instrument checkride. Secondary objectives were to (1) identify and assess specific instrument maneuver performance differences by student pilots whose total flight times ranged between 100 and 200 hours, and (2) determine whether differences in total flight time affected the general process by which daily instrument flying skills were learned.

METHOD.

The experiment was carried out utilizing E-RAU students and training facilities. Three experimental training groups (A, B, and C) were constituted from E-RAU student volunteers. Each group received standard instrument training after varying amounts of total flight experience. Group A began its instrument training after 67 hours, Group B after 100 hours, and Group C after 130 hours of total flight experience. Each group was then administered a

standardized instrument checkride after completion of their instrument training. A total of 96 subjects, all without any previous flight experience, began the program. Of these, 79 subjects completed instrument training (27 in Track A, 26 in Track B, and 26 in Track C).

Because this study was intended to address factors pertaining only to experience as defined by number of flight hours, the content and sequence of training for experimental tracks were controlled to the greatest possible extent. Further, the content and sequence of instrument training itself were standard across tracks. The experimental design called for three sets of data for each track: (1) measures of flight proficiency on a contact checkride administered prior to instrument training; (2) daily progress measures administered during instrument training; and (3) measures of flight proficiency on an instrument checkride administered upon completion of instrument training. Objective, inflight, data collection forms were used to gather these data.

In addition to the objective measures of checkride performance, provision was made for checkpilots to assign, on a subjective basis, a letter grade to the performance of each maneuver by each student on both contact and instrument checkrides. Letter grades also were to be assigned to each of four "flight quality" dimensions describing overall checkride performance.

The checkpilots underwent a carefully defined and supervised six-day training program. All procedures followed by checkpilots when recording data were standardized. Eight checkpilots and 13 instructors were involved in the collection of the data. All data were collected during flights of Cessna 172-N aircraft in the E-RAU fleet.

The contact and instrument checkrides each yielded two types of measures for analysis. First, adequacy of performance was represented objectively in terms of a percent error score. That is, for each maneuver and for all maneuvers scored during a given checkride, the number of maneuver components for which performance was out of tolerance was divided by the total number of scored components and multiplied by 100. Second, (subjective) letter grades assigned by checkpilots to each maneuver and to each of the four "flight quality" categories were analyzed.

RESULTS.

Analyses of variance performed on contact checkride performance revealed no statistically significant differences among tracks with regard to either objective or subjective measures. This finding supported the hypothesis that any proficiency differences among tracks on the instrument checkride would be a function of the experimental treatment (i.e., training time) rather than initial flight skill differences.

Analysis of the objective instrument error rate scores, the data of primary interest in this study, indicated that differences among the three tracks were not statistically significant. Such differences as did occur in these error rates favored the two lower time tracks (A and B) over the track (C) with the greatest amount of total flight time. One-way analyses of variance for the mean instrument checkride letter grades and flight quality grades resulted in statistically significant differences among tracks on both measures. However,

these differences were consistent with the instrument objective error rates in that Track C received poorer maneuver and flight quality grades than Tracks A and B. These findings clearly support the interpretation that lesser amounts of prior flight time had no adverse effects on instrument checkride performance.

Meaningful analyses of daily training performance data could not be made because the data often were neither comparable across students nor from day to day for a given student. Summaries of these data are presented, nevertheless. Since training was individualized to allow each student to reach proficiency, amount of instrument training given could vary. As a consequence, significant differences were found for the amount of time given during instrument training, with Group A receiving more instrument training time than Groups B and C.

DISCUSSION.

The present study was performed to determine whether level of pilot experience, as represented by three different quantities of total flight time, affects the ability to acquire and demonstrate instrument flight skills. The results of this experiment suggest that total flight time, within the range examined, had no significant effect with regard to the level of instrument flying skill achieved. It would thus appear that prior flight time should not be considered a primary factor in defining requirements for the instrument rating. This conclusion is supported not only by the data reported here, but also by post-study discussions with checkpilots and instructors and by review of the research literature on instrument and contact flight training.

Given that total flight hours is not relevant as a requirement for the instrument flight rating, it is suggested that the most reasonable alternative consists of careful definition of the minimum skills and knowledge required to operate safely under instrument meteorological conditions, in conjunction with the development of performance standards and objective measurement procedures to ensure the attainment of such skills and knowledge. Therefore, a systematic process consisting of identification and development of three components--requisite skills, standards for their assessment, and performance measurement methods encompassing these standards--appears necessary if general aviation training and rating/certification requirements are to be optimized.

It would appear that the 200-hour experience requirement has, for the past forty years, functioned, at least in part, as a de facto substitute for such performance standards. However, the present results suggest strongly that the 200-hour experience requirement is likely irrelevant to such a function.

CONCLUSIONS.

- Within the ranges of pre-instrument flight experience examined in this study and for the subject population used, amount of prior flight time had no effect on the acquisition and demonstration of instrument flight proficiency.

- Consideration should be given to extending the results of this study to other populations and to reducing the present 200-hour experience requirement for issuance of an instrument rating as a means of encouraging earlier training of instrument skills.

PREFACE

This report describes an investigation of the effects of pilot experience, as defined by total flight time, upon the acquisition of instrument flying proficiency. It has been noted that low-time, non-instrument rated pilots are often--perhaps disproportionately often--involved in fatal weather-related accidents because they inadvertently become involved in weather conditions they are not prepared to handle. As a result, there has developed a general concern that the current 200-hour experience requirement for the instrument rating (FAR 61.65) may postpone unnecessarily the commencement of instrument training until pilots have obtained approximately 150 hours of flight time. Thus, a question has arisen as to the feasibility of reducing the 200-hour experience requirement with the objective of decreasing the incidence of weather-related accidents among low-time pilots.

The purpose of the present effort, conducted under contract from the FAA Technical Center and Office of Systems Engineering Management, was to provide empirical data for determining the advisability of reducing the flight experience requirement for the instrument rating. This study was jointly conducted by the Seville Research Corporation and Embry-Riddle Aeronautical University (E-RAU). Seville's activities were conducted under subcontract to the prime contractor, E-RAU. The prime contract (DOT-FA79NA-6040) with the FAA involves several tasks concerned with the identification of human factors problems in general aviation as well as the development of research strategies to reduce or alleviate such problems. A final report of the first of these tasks (Task 1), entitled Human Factors Problems in General Aviation, appeared in July 1980. The present effort represents Task 2 of this task order contract. A second phase of the present effort is underway to extend the results to other general aviation population subgroups.

Seville was responsible for the study design and data analyses in the present effort. E-RAU was responsible for the flight program development, training of students, provision of necessary facilities, equipment, support personnel, and inflight data collection.

Dr. Jerome I. Berlin, Director of E-RAU's Research Center, is Program Manager for the prime contract. Dr. Wallace W. Prophet served as Seville's Program Manager for this effort, and Dr. Jerry M. Childs was Seville's Project Director. Dr. William D. Spears of Seville was responsible for much of the data analysis. Mr. E. Peter Denlea of E-RAU's Research Center coordinated all research activities and provided management assistance, while flight training direction and data quality control assistance were provided by Dr. Tom Connolly of the College of Aviation Technology, E-RAU. The Contracting Officer's Technical Representative (COTR) for the FAA Technical Center was Mr. Douglas Harvey.

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I. INTRODUCTION

General aviation consists of all elements of the nation's aviation activity except air carrier and military operations. With its some 200,000 aircraft, 800,000 pilots, and extremely diverse tasks and missions, its scope encompasses a substantial portion of the nation's entire aviation activity (AOPA, 1980). Furthermore, general aviation's growth rate for the next decade is expected to follow the vigorous patterns observed during the past five years. According to projections (FAA, 1979a; AOPA, 1980), by 1991 the general aviation fleet will be almost 304,000, a growth of 52%, with the general aviation pilot population reaching approximately 1.2 million (increase of 50%). Similarly, the number of general aviation hours flown is projected to increase from 39 million in 1979 to approximately 64 million by 1991, an increment of 64%. Overall, most of the growth will be due to increasing use of general aviation aircraft to fulfill business-oriented missions.

Accompanying this development will be others that affect general aviation. For example, sophistication of avionics will increase; there will be a greater number of instrument operations resulting from the need to operate under a broad range of weather conditions; adaptations must be made in air traffic control requirements and procedures; and general aviation aircraft will operate increasingly within areas not served by the air carriers. As a result, general aviation development will carry with it several problems. In addition to problems such as fuel and airspace allocation, a major concern will be the reduction of what is considered by many to be an unacceptably high accident rate. Despite recent improvements in this rate, it remains a prime concern as the size and complexity of general aviation increase.

The accident rate could be reduced if the interactive factors that operate on the general aviation system and that contribute to unsafe flight are identified and appropriate steps are taken to reduce their effects. The National Transportation Safety Board (NTSB) has compiled a considerable body of data related to causes and contributing factors in general aviation accidents. Despite deficiencies in these data (Shelnutt, Childs, Prophet, & Spears, 1980), they provide substantial insight concerning accident causation by identifying system factors that lead to unsafe aircraft operation and that can be corrected. The interaction of two such factors identified in the NTSB data, adverse weather conditions and pilot experience level, was the focus of the study effort reported here. Pilots sometimes fly in degraded weather before they have acquired the instrument flight skills needed for safe aircraft operation in such conditions. Whether the pilots do so by choice, or are inadvertently caught in unexpected changes of weather, they have been described as "accidents waiting to happen."

The purpose of this study was to investigate the feasibility of teaching the needed instrument skills earlier in the pilot's flight experience than is usually the case. If it is feasible, and suitable training requirements are identified and instituted, there should be a resulting reduction in general aviation accidents that derive from the joint conditions of adverse weather and low-time pilots' inadequacies to contend with it.

Before stating the specific objectives of the study, the context for the issues addressed will be explained.

BACKGROUND.

Two NTSB reports for overlapping time periods clearly reveal the role of adverse weather in aircraft accidents. While for the eleven-year period ending in 1974, adverse weather was cited as a cause or contributing factor in only 19% of all general aviation aircraft accidents, weather was a factor in 38% of those that resulted in fatalities (NTSB, 1976). For the more recent period from 1969 through 1978 (NTSB, 1980), weather-related accidents resulted in an average of 642 fatalities per year. The latter report also cited weather conditions as a cause or contributing factor in fatal accidents more often than any other cause or factor.

Adverse weather obviously poses a variety of dangers for flight. When pilots willingly or unwillingly fly into degraded weather conditions, they must contend with the problem as best they can. Generally, successful flight under such conditions requires skill in handling the aircraft while depending primarily on instruments for cues. Yet, in the weather-related accidents involving fatalities, the most frequently cited detailed cause/factor was continued VFR into IFR conditions (i.e., dependence on visual flight rules [VFR] when instrument flight rules [IFR] were indicated) (NTSB, 1980).

It is difficult to pinpoint overall the extent to which the pilots involved in weather-related accidents simply were not qualified for IFR flight because the data needed are not available. Some supportable inferences to that effect are possible, however. First, of the 322 general aviation pilots involved in fatal, weather-related accidents in 1978, some 189 or 59% did not hold instrument ratings (NTSB, 1980). A second set of data (NTSB, 1974) covers the period 1964-1972. These data are plotted in Figure 1 where it is apparent that approximately half of 701 such accidents[1] involved pilots with no "actual" (i.e., IFR flight conditions) instrument time. (Some had had experience "under the hood," however.) An additional 20% had completed fewer than 20 hours actual instrument time.

A slightly different perspective for the problem is shown in Figure 2. These data are from the 1976 NTSB report covering the period 1964-1974. Of more than 5,200 nonfatal, weather-related accidents, 83% involved pilots with fewer than 100 hours of pilot experience. It is not clear how many of these accidents by almost 4,400 "low-time" pilots were due (in addition to the weather) to inadequate IFR skills. However, the fact remains that they had fewer than 100 hours in the air, and instrument certification cannot be obtained until 200 hours have been accumulated (FAR 61.65). Furthermore, beginning pilots, who typically must pay the entire cost of their training, generally do not begin instrument training until they have acquired enough flight time (150-160 hours) to obtain the rating upon completion of the 40-50 hours of instrument training typically required. While acquiring their first 150-160 hours of

[1] Data concerning the pilot's actual and simulated instrument flight experience were available for only 701, or 35%, of the total 2,026 fatal weather-involved accidents during that period.

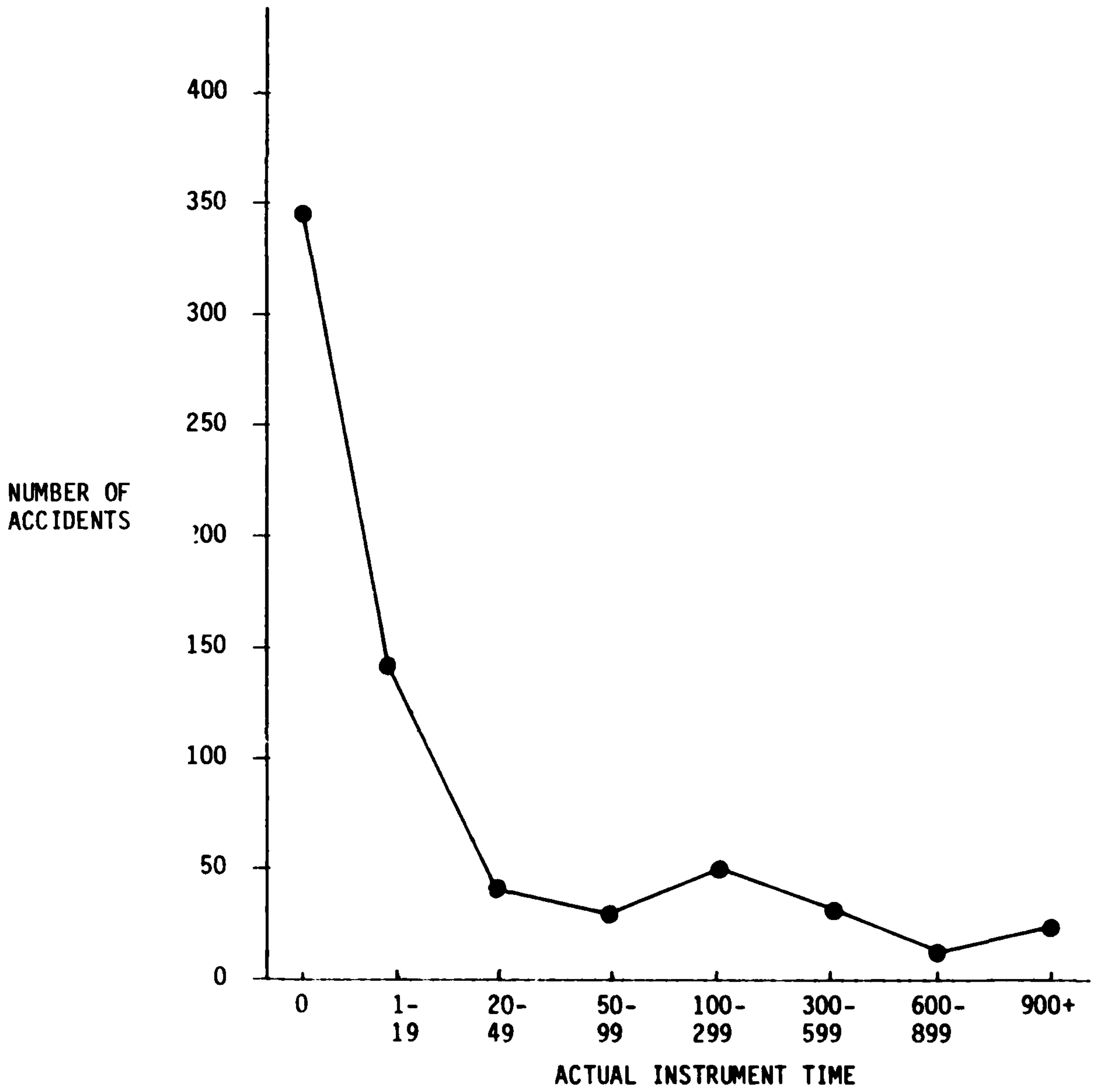

FIGURE 1.--NUMBER OF HOURS OF ACTUAL INSTRUMENT TIME OF PILOTS INVOLVED IN 701 FATAL WEATHER-RELATED ACCIDENTS IN 1964-1972 (NTSB, 1974).

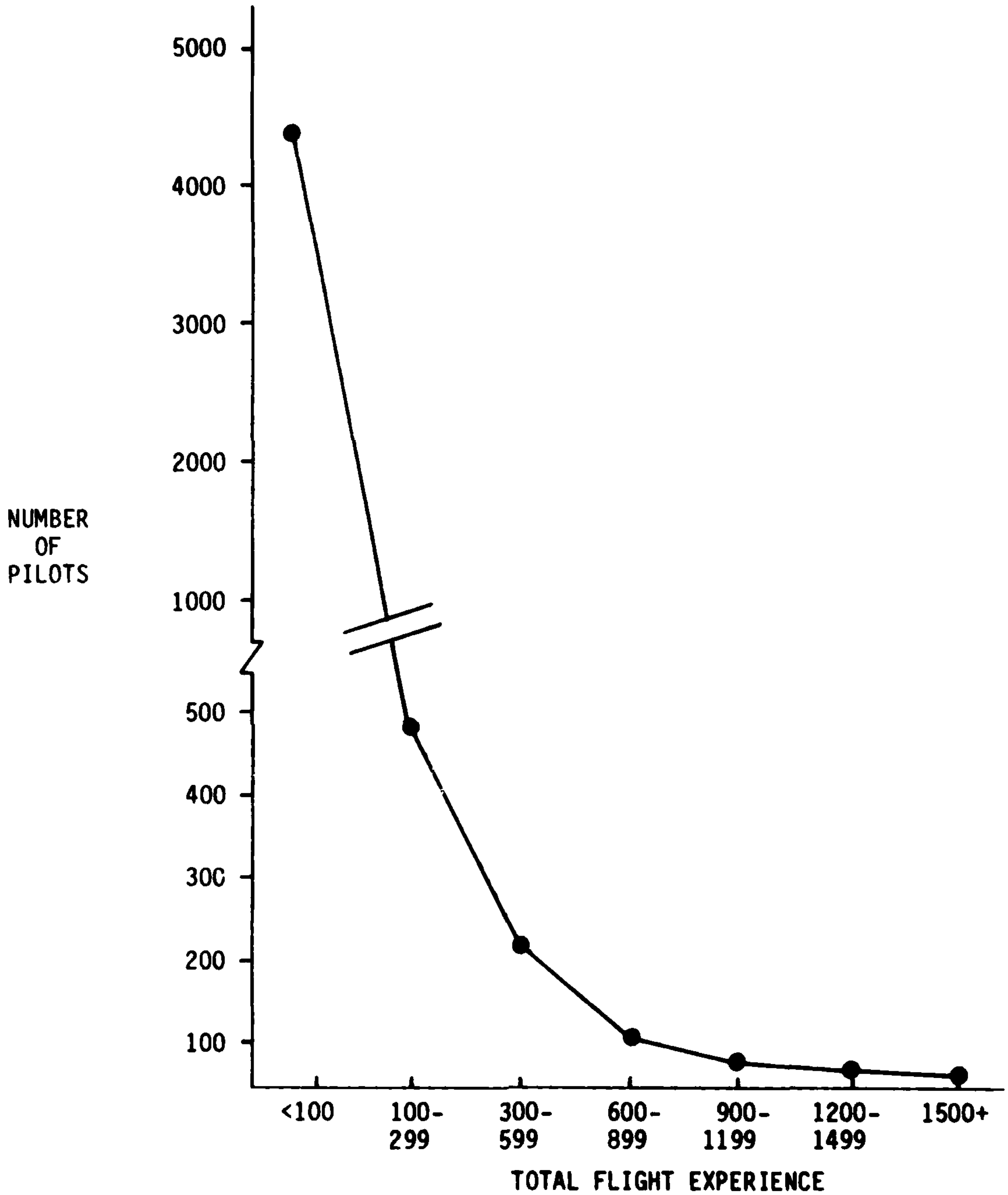

FIGURE 2.--NUMBER OF PILOTS INVOLVED IN 5,232 NONFATAL WEATHER-RELATED ACCIDENTS IN 1964-1974, BY TOTAL HOURS OF FLIGHT EXPERIENCE (NTSB, 1976).

experience, there is a high probability that a number of these beginning pilots will encounter weather conditions in which IFR skills will be needed, and, as is readily apparent, often with disastrous results.

THE 200-HOUR EXPERIENCE REQUIREMENT.

Except for Airline Transport Pilots, there was no civil aviation instrument rating requirement prior to about 1940. At that time, instrument rating requirements were written into Part 20 of the old Civil Air Regulations. The 200-hour requirement apparently originated at that time. The rationale for its designation was not identified, however. A comprehensive review of the literature concerned with contact and instrument training in general aviation revealed no evidence that the requirement was based on any empirical data regarding instrument training and performance.

The requirement was probably established more or less arbitrarily, following the pattern of development of contact and instrument flying (Jolley, 1958). Contact flight came first historically, and it has continued to be taught first. The thinking seems to have been that because contact skills are easier to learn than instrument skills (Ritchie & Michael, 1955), the former should be taught first and practiced thoroughly prior to learning instrument skills.[1] Accordingly, minimum instrument rating experience requirements should ensure a high degree of mastery of contact skills, and 200 hours total flight time was considered adequate for such purpose.

The validity of this experience requirement has been questioned by a number of persons, however. Indeed, the preamble to FAR Part 61 states that in 1964, a reduction of the requirement was proposed and was rejected because of adverse public reaction. Among other considerations, there was a concern among veteran pilots that novice pilots would resort to instrument flight in controlled airspace before they had sufficiently mastered the necessary flight skills, thus endangering others as well as themselves. The proposed reduction in the 200-hour requirement was therefore rejected. Instead, it was decided to focus on improving the safety of instrument flight through increased instruction in IFR skills.

While increased instrument training addressed the issue of safety in controlled airspace, it did nothing to alleviate the problem of low-time pilots operating in IFR weather conditions without the instrument skills needed for safe flight. The 180° Turn Program, which emphasizes escape from such conditions, more directly addressed the problem. Further, the FAA's "Blue Seal" program, which was implemented in the mid 1970s, was a step toward the acquisition of instrument skills early in pilot training. This program

[1] In contrast, the available research literature (see Appendix A) would suggest that this is the least effective and efficient sequence for teaching such skills. The sequence of "instruments first, then contact" and the so-called integrated or composite training approach are both more effective and efficient than the typical "contact first, then instruments" sequence.

emphasizes the importance of aircraft control by reference only to instruments. All private pilot candidates are thus required to receive some basic instrument instruction "under the hood."

Even so, most would contend that such minimal under-the-hood instruction does not substitute for more comprehensive standard instrument training when IFR competence is required. And in view of the alarming frequency by which low-time pilots continue to be involved in fatal weather-related accidents, the question of the advisability of the 200-hour requirement for issuance of the instrument rating has again arisen. The problem is serious, for of the 799,000 general aviation pilots in 1979, 26%--205,000--were in some form of training, and many of these had not progressed to the 200-hour level of experience.

There have been several recent calls for a reduction in the 200-hour requirement. For example, two working groups at the General Aviation Workshop at Ohio State University made a recommendation to this effect (Lawton & Livack, 1979). The feasibility of such a reduction in the requirement is supported by current military training practices. In all branches of the military, instrument skills are developed very early in pilot training. A review of literature on integration of contact and instrument training, which appears as Appendix A of this report, lends further support, at least in the sense that instrument skills <u>can</u> be taught quite early in training, even prior to contact skills.

The recommendation by the Workshop groups at Ohio State University, current military practices, and inferences from the literature review are based on rational analyses of flight skills and offer indirect support for a possible reduction of the 200-hour experience requirement. What is lacking are empirical data to validate such judgments directly in terms of current general aviation training practices. Can it be demonstrated, for example, that student pilots can achieve proficiency in instrument flight skills well before they complete 200 hours of total flight experience? While an affirmative answer to this question does not, of itself, resolve all the questions relevant to a possible reduction in the 200-hour experience requirement for the instrument rating, it would clarify an important aspect of the problem.

OBJECTIVES OF THE STUDY.

The primary objective of the experiment reported here was to determine the effects of varying amounts of prior flight experience on the level of instrument flight skills acquired by students in a standard instrument training program as demonstrated by their performance on the instrument checkride. Both overall instrument flight performance and performance on separate maneuvers were of concern.

A secondary objective was to determine whether differences in total flight time affected daily progress in the learning of instrument flight skills.

The results of this study will be one of several considerations relevant to possible revision of certain FAA policies. It was important, therefore, to obtain data of the greatest possible validity. Accordingly, the emphasis was upon objective measures of actual pilot performance whose validity had been

established. At the same time, the value of judgments of expert standardization pilots was recognized. Procedures for collecting data were standardized, and persons responsible for recording data were carefully trained in the use of these procedures. To ensure applicability of the findings to realistic training and operational conditions, a well established, ongoing training syllabus and instructional setting were used. It was necessary, of course, to control carefully the implementation of certain aspects of training and subsequent checkride evaluations so as to prevent effects on data from extraneous factors. The control did not, however, reduce the practical realism of training, as will be seen from descriptions of data collection methods in the following section.

The experimental controls described allowed the development of valid information within the general context of the effort. However, results necessarily must be interpreted in light of the population of subjects used, the training setting, and the aircraft involved. Additional research is currently underway to extend the results in terms of those dimensions.

II. METHOD

EXPERIMENTAL SETTING.

This study was carried out using regularly enrolled students at Embry-Riddle Aeronautical University (E-RAU), Daytona Beach, Florida. This aviation-oriented school prepares students for careers in all aspects of aviation. Its use of the latest aviation and training technology and its employment of highly qualified professional personnel provided a setting that permitted an adequate level of experimental control without sacrifice of training quality. E-RAU programs in Flight Technology (Private, Commercial, Instrument, Multi-Engine, Flight Instructor, and Instrument Flight Instructor) as well as its programs in Maintenance Technology (Airframe and Powerplant) are FAA-approved. Student advancement through the E-RAU curriculum is individualized and is based upon demonstrated proficiency; and E-RAU maintains self-examining authority under the direction of FAA's General Aviation District Office in Jacksonville, Florida.[1] Under this authority, students in the Commercial Course at E-RAU, from whom the groups used in this study were selected, typically receive instrument ratings after about 170-180 total flight hours. They do, however, complete approximately 200 hours by the end of the course.

EXPERIMENTAL DESIGN.

The question addressed in this study concerned the efficacy of standard instrument training as a function of differing amounts of total flight experience. However, "total flight experience" requires definition within the context of the training programs utilized here. All subjects followed the same sequence of training phases with the exception that instrument blocks (Basic Attitude Instruments/Radio Navigation and IFR Operations) appeared at different points in the training sequence. Hence, subjects who received instrument blocks at later points also had completed one or more contact blocks in the sequence that subjects receiving instrument training relatively early had not yet been through. Any differences among groups thus necessarily would reflect not only total flight hours but training content (other than instrument) as well. However, this mixing of both quantity and quality of experience is characteristic of the manner in which private pilots typically increase their experience levels.

Following this rationale, three groups of subjects underwent the same training regimen except for the point at which their approximately 40 hours of instrument training began. Subjects in one group (Track A) were to begin instrument training soon after receiving their private pilot certificates, i.e., after 65-70 hours of total flight time; a second group (Track B) after 100 hours; and a third group (Track C) after 130 hours. Although Track C would complete

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[1] The criteria, privileges, and limitations associated with Pilot School Examining Authority are described under Subpart D of FAR Part 141 (141.63; 141.65; 141.67). Essentially, the holder of examining authority may award graduates of the school's approved certification courses the associated pilot certificate or rating without their having to be examined by FAA. However, FAA does maintain a continuing surveillance of such activities as a quality control and assurance mechanism.

their instrument training with somewhat less than the FAR instrument rating requirement of 200 hours, this track was representative of students enrolled in the standard E-RAU Commercial Course with regard to total flight hours at the instrument checkride. Thus, Track C was considered a control group relative to the two lower-time tracks.

Three sets of data were to be obtained for each track: (1) measures of flight proficiency on a contact checkride; (2) daily progress evaluations during instrument training; and (3) measures of instrument checkride performance. The nature of these measures and procedures for obtaining them are described later.

Comparisons of the instrument checkride measures across tracks were intended to reveal the effects, if any, of total flight hours on instrument flight proficiency at the end of instrument training. The other two sets of measures were to aid in interpreting these comparisons.

SUBJECTS.

Because this study involved some variation from the standard E-RAU curriculum, subject participation was voluntary. Their cooperation was sought through letters mailed to course applicants prior to their enrollment, and through subsequent interviews with E-RAU Research Center personnel and orientation briefings. There were at least two incentives for participating in the study: an opportunity to obtain an instrument rating relatively early in training; and a reduction in costs due to the possible reduction in flight hours corresponding to earlier instrument certification.

A total of 96 volunteers, all without any previous flight experience, were selected from among the applicants for the Commercial Pilot Course. Thirty-two were assigned to Track A, 34 to Track B, and 30 to Track C. However, attrition during training resulted in 27 students remaining in Track A and 26 in each of the other two tracks, for a total of 79. For detailed information regarding individual students, refer to Appendix B.

Descriptive indices for the three groups of subjects are shown in Table 1. Statistical significance tests reveal that distributions of sex, age, and attrition were comparable across all groups for subjects who did not drop out. Although the percentages of attrition appear to differ more than the other measures, they are well within sampling (chance) expectations. (The chi squared for attrition was only 1.28, well below the 5.99 value necessary for significance at the .05 level.) However, the groups did differ significantly in terms of their academic grade point average (GPA) through the courses of concern here. The analysis of variance test yielded an F of 5.55, which with 2 and 76 df is significant at the .01 level.[1]

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[1] Most group data in this report are presented in terms of summary statistics such as the Mean (M) and the Standard Deviation (SD). Group differences are evaluated through tests of statistical significance which, in turn, yield probability or significance level statements (e.g., $p < .05$ means that there are fewer than 5 chances in 100 that a difference is due to chance alone). In general, the smaller the p value, the more significant is the difference being evaluated. For a more detailed discussion of the statistical methodology and terminology used, the reader is referred to Appendix C.

TABLE 1.--DESCRIPTIVE DATA FOR SUBJECTS WHO COMPLETED THE EXPERIMENT

Track	Number of Subjects			Age		GPA		% Attrition
	Male	Female	Total	M	SD	M	SD	
A	24	3	27	20.9	2.1	2.8	0.5	15.6
B	23	3	26	20.2	1.4	2.8	0.5	23.5
C	22	4	26	20.6	1.9	2.4	0.5	13.3

The subjects received their training (i.e., from initiation of private pilot training through the instrument training) during the period September 1979 through December 1980. For administrative reasons, it was not possible to have all three tracks in training at the same time. Accordingly, Track B began training during the Fall trimester in 1979, Track A during the Spring and Summer trimesters of 1980, and Track C during the Summer and Fall trimesters of 1980. As a result, assignment of subjects to tracks could not be randomized. Nevertheless, the groups comprising the tracks were generally comparable, though some differences, such as that for GPA, did result. However, as will be noted subsequently, there were no significant differences in flight performance among the groups as they began their instrument training.

DEVELOPMENT OF MEASURES AND RELATED PROCEDURES.

Measuring instruments and corresponding procedures were developed to obtain the sets of data identified above. Three criteria were applied to each measure. First, the measure must adequately sample aspects of the performance to be evaluated. Second, the procedures to be employed must have been demonstrated to be valid and reliable. Third, the data obtained must permit a meaningful quantification of the performance to be evaluated.

All three criteria were met by suitable adaptations of the widely used Pilot Performance Description Record (PPDR) developed by Smith, Flexman, and Houston (1952), Greer, Smith, and Hatfield (1962), and Prophet and Jolley (1969). The proper use of the PPDR involves a standard administration sequence for maneuvers to be evaluated and a standard order of segments comprising each maneuver. To the extent practical, objective measures are obtained by reference to flight status indicators (instrument readings such as airspeed, heading, etc.) relative to criterion values and permissable deviations. Also, pilot actions are reported in terms of observable pilot behavior. Due allowance is made for recording judgmental assessments by persons administering the measure, but here, too, procedures and bases for decisions are such as to focus on pertinent aspects of performance, and to ensure reliable measures.

Given a well validated instrument such as the PPDR, the primary tasks in adapting it for the present study were ensuring adequate samples of performance to be evaluated during contact and instrument checkrides, and defining

desired performance and tolerances. For this purpose, the following documents were reviewed:

E-RAU Commercial Pilot Certification Syllabus

E-RAU Operations Manual

E-RAU (Contact and Instrument) Procedures Guides

E-RAU Student Workbooks (Contact and Instrument Courses)

The Student Pilot's Flight Manual (Kershner, 1979)

The Flight Instructor's Manual (Kershner, 1974)

The Instrument Flight Manual (Kershner, 1977)

Cessna Manual of Flight (1980)

Information Manual, Cessna Model 172 N (1978)

Piper Private Pilot Manual (1979)

FAA Aviation Weather Guide (FAA, 1979b)

FAA Private Pilot Flight Test Guide (FAA, 1975)

FAA Instrument Flight Test Guide (FAA, 1976)

FAR Parts 61, 91, and 141

The Proficient Pilot (Schiff, 1980)

This material provided information concerning the training of VFR and IFR piloting skills, as well as information related to the tasks, maneuvers, and procedures employed to assess these skills. In addition, structured conferences with E-RAU checkpilots held early in the project provided much helpful information concerning acceptable performance parameters for the candidate maneuvers to be included in the experiment.

Following selection of a set of candidate maneuvers to evaluate during the contact and instrument checkrides, each maneuver was analyzed and discussed further with E-RAU checkpilots and other subject matter experts to determine fundamental skill components. Feasible patterns were then determined for observing and recording various aspects of performance, with segmentation points within and between maneuvers defined according to control transitions required to follow a desired flight path and to maintain flight status indicators within tolerance limits. The two PPDRs that resulted (1) provided measures of a representative sample of checkride performance, (2) were compatible with FAA and E-RAU checkride procedures, (3) were comprehensive for the measures involved, and (4) permitted efficient manual recording of data during flight.

THE CONTACT PPDR. Appendix D presents the Contact PPDR together with its associated Handbook, Performance Measures, and Checkpilot Training Syllabus. Eight maneuvers were involved:

1. Short field takeoff and departure
2. Approach to landing stall recovery
3. Slow flight
4. 180° instrument turn
5. VOR procedures
6. Turns about a point
7. Traffic pattern
8. Soft field landing

The 180° instrument turn and VOR procedures were included to assess two instrument tasks of the Private Pilot Blue Seal training requirements mentioned earlier. The 180° instrument turn required the student, while flying under the hood, to maintain a relatively constant bank angle, airspeed, and altitude while turning 180°. The VOR problem, which included only identification and initial track-to-station segments, was also performed under the hood. The eight maneuvers included a total of 86 separate measures of performance which covered a representative sample of the skills required for maneuvers described in the FAA Private Pilot Flight Test Guide (AC 61-54A).

THE INSTRUMENT PPDR. This measure was more comprehensive than the Contact PPDR because it was to be used to obtain the primary criterion data for the study. Nevertheless, the Instrument PPDR represented a sample of instrument maneuvers rather than the complete set. Twelve maneuvers were involved:

1. Straight and level flight
2. Magnetic compass turn
3. Slow flight
4. VOR procedures
5. ADF procedures
6. ILS procedures
7. Holding
8. Procedure turn
9. Cross-country operations

10. Radar vectors

11. Emergency procedures

12. Unusual attitude recovery

There were 98 separate performance measures included in the twelve maneuvers. This PPDR, along with its corresponding Handbook and Performance Measures appears in Appendix E.

SUPPLEMENTARY CHECKRIDE DATA. In addition to the PPDR measures, provision was made for checkpilots to assign, on a subjective basis, a letter grade (A, B, C, D, or F) to the performance of each maneuver by each student. These letter grades were recorded at the bottom of each PPDR maneuver form. In addition, letter grades of A, B, C, D, or F were to be assigned to each of four "flight quality" dimensions describing overall checkride performance. For the Contact PPDR, flight qualities were (1) Flight Safety, (2) Smoothness, (3) Planning and Judgment, and (4) Collision Avoidance. For the Instrument PPDR, the first three flight qualities were again Flight Safety, Smoothness, and Planning and Judgment, but the fourth was Communications Procedures.

Finally, provision was made for designating the presence or absence of turbulence during performance of a maneuver. The Airman's Information Manual was used to define turbulence levels when training the checkpilots to use the PPDRs, but during checkrides the checkpilots were to designate judgmentally only whether turbulence was present or absent.

DAILY PROGRESS RECORD (DPR). A further adaptation of the PPDR scoring procedure was made for the recording of daily performance during instrument training. The maneuvers involved were:

1. Straight and level flight

2. Airspeed change

3. 180° turn

4. Climb/descent

5. VOR procedures

6. ADF procedures

7. ILS procedures

8. ILS missed approach

9. Holding

10. Procedure turn

11. Cross-country procedures

12. Emergency procedures: Loss of radio communications

13. Emergency procedures: Equipment/instrument malfunction

14. Unusual attitude recovery

As can be seen, with the exception of additional basic instrument maneuvers (2, 3, and 4), the DPR measures were essentially the same as those included in the Instrument PPDR, except that a separate score was recorded for ILS missed approach and for separate subsets of emergency procedures.

In all, some 106 separate measures, at least four for each maneuver, were included on the Instrument DPR. A copy of the DPR appears in Appendix F, along with the corresponding User's Guide and Performance Measures.

CHECKPILOT FAMILIARIZATION TRAINING. As previously noted, E-RAU checkpilots were consulted quite extensively in the development of the PPDRs. However, to ensure that the checkpilots were sufficiently familiar and practiced in the use of these inflight recording forms prior to actual data collection, they underwent a carefully defined and supervised six-day training program. Prior to beginning this training, they were briefed collectively by a Seville investigator and individually by a flight training manager concerning use of the forms as a research tool. The contents and schedule for the checkpilot training program are presented in Appendix D.

PROCEDURE.

TRAINING REGIMENS. Figure 3 presents the sequences of training phases for Tracks A, B, and C. The three tracks depart[1] only slightly from the standard E-RAU curriculum, which also appears in the right hand portion of Figure 3. Except for the time for initiating instrument training and the deletion of the normally scheduled back seat observer time, the only discrepancy is the reverse order of Commercial Maneuvers and Advanced Solo Cross-Country for all three tracks as compared to the standard curriculum.

The portions of the training of specific concern in this study are those leading up to and included in instrument instruction. As shown in Figure 3, all three groups first went through a common sequence, beginning with a Presolo block and progressing through Basic Flying, Presolo Cross-Country (X-C), Private Pilot, and Night Operations. (See Appendix G for further information concerning these and other blocks.) At this point, Track A began BAI/Radio Navigation, followed by IFR Operations, while Tracks B and C underwent Advanced Solo X-C. Track B then took the BAI/Radio-IFR blocks while Track C followed Advanced Solo X-C with Commercial Maneuvers. Finally, Track C followed Commercial Maneuvers with the BAI/Radio-IFR blocks. Training following IFR Operations was not of concern in this study. However, it was the same across groups except as the sequence was interrupted by introduction

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[1] Training hours waiver and self-examining authority for each experimental group were approved by the FAA General Aviation District Office in Jacksonville, Florida.

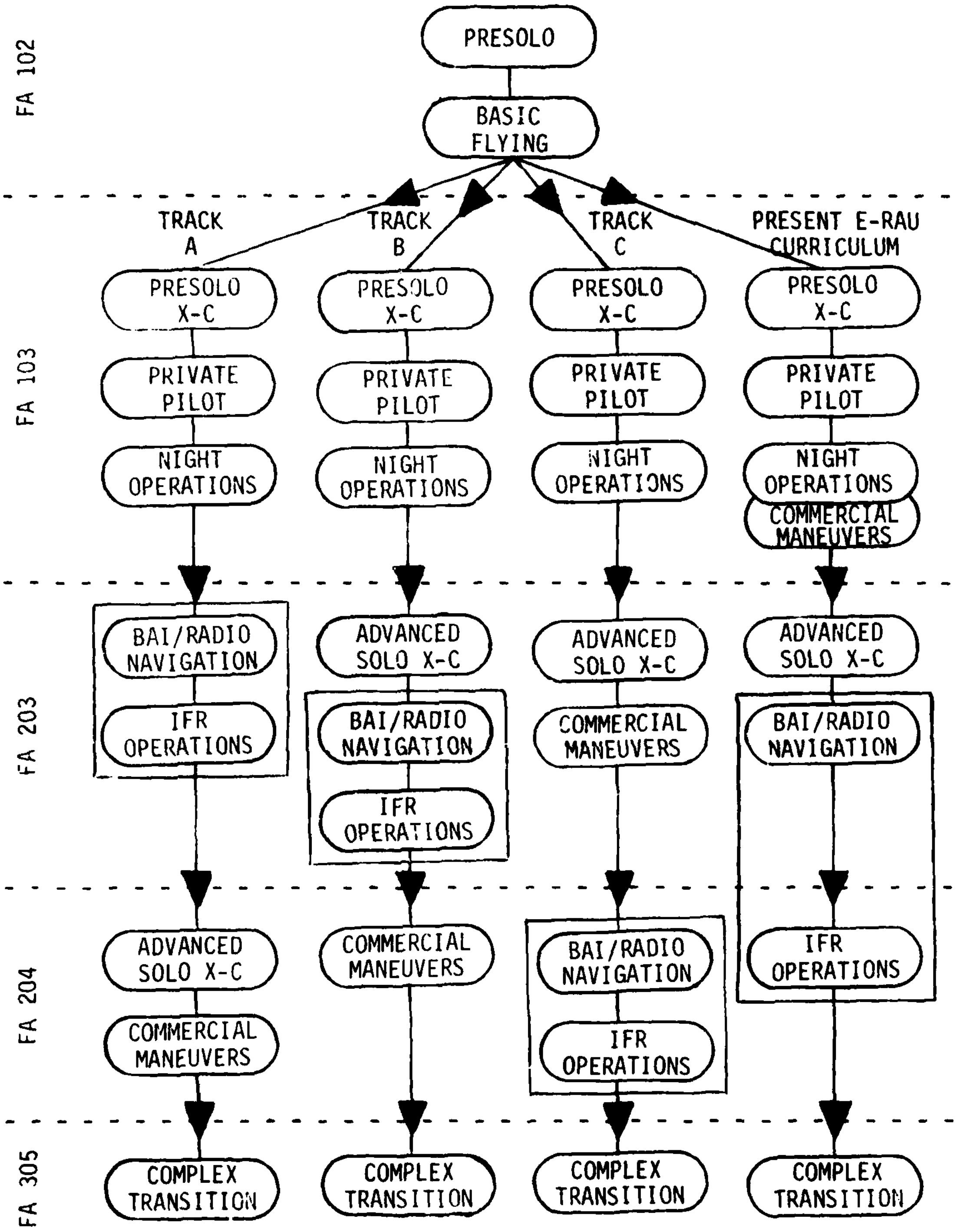


FIGURE 3.--E-RAU EXPERIMENTAL TRACKS FOR THE COMMERCIAL PILOT CERTIFICATION COURSE.

of instrument training at the different points just identified. For ease of identification, the instrument training (BAI/Radio Navigation and IFR Operations) is enclosed in a box in Figure 3.

A total of 13 instructors served the three tracks. Information regarding individual instructors appears in Appendix H. Their mean age was 22.9 years, and their mean prior flight experience was 1,329 hours. The mean number of hours they had provided inflight instrument instruction was approximately 122, and of dual flight instruction with students, 327. In addition to their responsibilities as instructors, those involved in instrument training recorded measures on the DPR daily for each student.

It was not possible to control, i.e., balance, assignments of instructors across tracks. In fact, there was a 35% turnover of instructors during the 16-month course of the experiment. All conformed to usual E-RAU training practices, however, and each track had at least 5 different instructors, thereby tending to minimize unique effects of any single instructor on the outcome of the study.

Similarly, the specific instruction and sequence of activities provided each student subject were not controlled in a rigid sense. That is, while each subject followed the structure of the syllabus for his or her track, training practices were adapted as needed for each student according to the judgment of the instructors.

There was a control, however, over the number of hours of flight time accumulated at the time of entry into instrument training. For Track A, every student had 67 hours, for Track B, 100 hours, and for Track C, 130 hours. Instrument training then progressed on an individualized basis as dictated by each student's needs. Mean exit hours (and standard deviations) for instrument training were 113.6 (7.2) for Track A, 138.5 (6.1) for Track B, and 171.2 (7.2) for Track C. These data are shown in Table 2.

TABLE 2.--INSTRUMENT TRAINING ENTRY, IN-TRAINING, AND EXIT TIMES BY GROUP

Track	Total Hours at Entry		Instrument Training Hours		Total Hours at Exit	
	M	SD	M	SD	M	SD
A	67.0	0	46.6	7.2	113.6	7.2
B	100.0	0	38.5	6.1	138.5	6.1
C	130.0	0	41.2	7.2	171.2	7.2

Note: Since all students in a given group had the same number of total hours at entry into the instrument training block, there was no variability (SD) of entry times within the group. The variability of exit hours within a group is necessarily identical with the variability of instrument training hours for that group because of the common entry hour level within each group.

PERFORMANCE DATA. The three sets of flight performance data identified earlier were collected for the three tracks at points determined by the initiation and conclusion of instrument training rather than by completion of other training blocks. Thus, contact checkride measures, obtained just before beginning instrument training, followed Night Operations for Track A, Advanced Solo X-C for Track B, and Commercial Maneuvers for Track C. Accordingly, Track A had the lowest number of flight hours prior to the contact checkride and C the highest. (However, as evident below, these checkride measures concerned aspects of performance for which fairly high degrees of mastery could be expected prior to the additional training Tracks B and C received before their checkrides. In fact, Track C had the highest error rate on the contact checkride, though as shown in the Results section of this report, their differences from Tracks A and B were not statistically significant.)

The second set of data comprised the daily performance records (DPRs) which were designed to reveal progress during the instrument training phase. While these measures were adequate to reveal progress of all tracks, the data were not sufficiently standardized for statistical comparisons of tracks. For example, differences in opportunities, students' needs and instructors' preferences regarding practice tasks, and individual students' progress, resulted in variations in types of performance rated from day to day, especially during the later stages of instrument training. These data are presented in Appendix I; however, in interpreting them, the reader should bear these variations in mind, especially the likelihood that the ratings in later stages of training emphasized skills that needed further practice rather than those already mastered. In other words, later overall progress is probably underrepresented in the data.

The third set of data, PPDR measures of instrument checkride performance, was obtained during the students' instrument checkrides which occurred upon completion of instrument training. These data are the primary focus of the analyses reported later because they are the critical indicators of the success of instrument training.

All data were collected during flights of aircraft in the E-RAU fleet of 48 Cessna 172 N planes. All aircraft were 1977-1980 models and were fully equipped for instrument flight. Procedures followed by checkpilots when recording data are described for each measuring instrument in Appendices D, E, and F. It should be pointed out, however, that checkpilots were asked to record performance immediately when it was not within acceptable limits (safety permitting). On the other hand, instances of acceptable performance could be recorded at the end of each maneuver. Thus, remembering which aspects of performance were or were not within tolerance did not pose a problem for data reliability.

Eight checkpilots were involved in the collection of the PPDR data, five of whom accounted for approximately 80% of all the checkride data collected. While the number of checkrides administered by each checkpilot could not be controlled across tracks, several different checkpilots administered checkrides within each training track.

Descriptive data concerning the checkpilots appear in Appendix H. Their mean age was 42 years, and their mean flight experience was 5,227 hours.

III. RESULTS

The Contact PPDR and Instrument PPDR each yielded two types of measures for analysis. First, adequacy of performance as measured on either PPDR was represented in terms of percent error. That is, for each maneuver and for all maneuvers scored during a given checkride, the number of maneuver components for which performance was out of tolerance was divided by the total number of scored components and multiplied by 100, thereby yielding a "percent error score." The second type of measure was the letter grade assigned by check-pilots to each maneuver and to each of the four "flight quality" categories. There was a substantial relationship between overall objective measures of maneuver performance and overall grades for the maneuvers (see Appendix J for these data). However, the relationship was not so high as to preclude the possibility that the two types of measures provided different kinds of evaluative information to some extent. Therefore, both types of measures were analyzed, as well as the grades on flight qualities.

While the primary concern was instrument checkride performance, data from the Contact PPDR will be considered first with regard to the comparability of the student groups comprising Tracks A, B, and C. It will be recalled that assignments to these groups were constrained by certain administrative considerations, so strict randomization of assignments was not feasible.

CONTACT PPDR.

Means (*M*) and standard deviations (*SD*) for total percent error and for average maneuver grades across all contact maneuvers are shown in Table 3 for the three tracks. Graphical depictions of these data are included in Appendix J. The percent error means were compared using a one-way analysis of variance (ANOVA). The calculated *F* was 1.05, which for 2 and 76 degrees of freedom (*df*) did not approach significance. Similarly, the standard deviations did *not* differ significantly when their squares were tested by the *Fmax* procedure of Hartley (Winer, 1971, p. 206). The obtained *Fmax* was 1.71, while a value greater than 2.50 would have been necessary for significance at the .05 level.

TABLE 3.--MEANS (*M*) AND STANDARD DEVIATIONS (*SD*) OF SCORES ON CONTACT CHECKRIDE

Track	*N*	PPDR Total % Error		Average Maneuver Grade	
		M	*SD*	*M*	*SD*
A	27	20.08	10.11	2.31	.63
B	26	20.35	13.23	2.24	.55
C	26	24.36	12.73	2.16	.61

A similar analysis was made of mean subjective grades assigned by checkpilots to each of the various maneuvers. Letter grades were scaled by assigning a value of 4 for A, 3 for B, 2 for C, 1 for D, and 0 for F. Means for individual students were obtained by summing the numerical equivalents of their grades across the eight maneuvers and dividing by 8. Again, significance was not even approached, for the calculated $\underline{F}$ for mean differences was .39, and the $\underline{F}$max for squares of standard deviations was 1.29.

In passing, it is interesting to note the variations in difficulty among the separate maneuvers scored on the Contact PPDR. Figure 4, which depicts mean percent error on the Contact PPDR, shows that considerable variations occurred. The pattern is quite consistent across tracks, however.

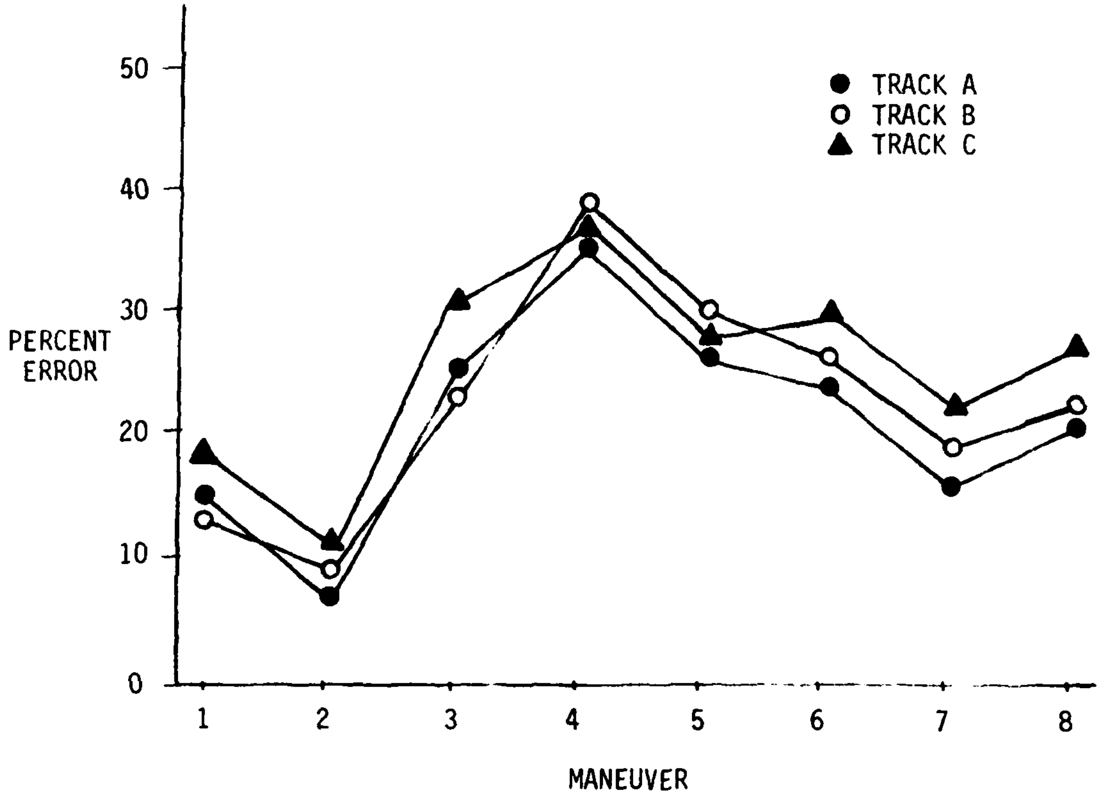
"Flight quality" grades were analyzed differently because the separate qualities were not sufficiently homogeneous in nature to permit a meaningful overall average. The analysis was an ANOVA for multiple observations on the same subjects. Groups to be compared were again the three tracks, and the multiple observations were numerical equivalents of grades on each of the four qualities. Only one $\underline{F}$ exceeded unity, 1.49 for differences among overall track means, and this value is far less than the tabled value (3.12) required for significance at the .05 level. A critical test of track comparability was provided by the track by quality interaction. The calculated $\underline{F}$ (0.33) indicated that the tracks were highly similar with regard to flight quality.

Failure to find significant differences among tracks does not establish that they were completely equivalent prior to instrument training. However, the low $\underline{F}$s obtained, and with sizeable $\underline{df}$s, mean that any differences that might have existed in the flight skills measured on the Contact PPDR were necessarily too small to affect interpretation of the data from the Instrument PPDR. This conclusion is supported further by the data presented earlier in Table 1 regarding the distributions of sex, age, GPA, and attrition rates for the three tracks, though it will be recalled that prior GPA did differ significantly.

INSTRUMENT PPDR.

Table 4 presents the means and standard deviations of PPDR total percent error and of maneuver grades for the three tracks on the Instrument PPDR. Graphical depictions of these data are included in Appendix J. A comparison of the percent error means using a one-way ANOVA yielded an $\underline{F}$ of 2.54 which is appreciably below the value of 3.12 required for statistical significance at the .05 level. The differences among standard deviations approached, but did not reach, the .05 level of significance, however, with an $\underline{F}$max also of 2.54.

For the purposes of this study, the $\underline{F}$ for means has a straightforward implication. While it is impossible to establish that the means differ only because of chance, the fact that statistical significance was not obtained indicates that if true differences existed, they were small. Further, the group with the greatest amount of flight experience prior to instrument training (and at the time of the instrument checkride), Track C, had the highest mean error. Hence, mean instrument checkride performance as measured by the objective portion of the PPDR was definitely not affected adversely by receiving instrument training early in the curriculum. However, it should be noted that each



1. TAKEOFF	5. VOR
2. APPROACH STALLS	6. TURNS ABOUT A POINT
3. SLOW FLIGHT	7. TRAFFIC PATTERN
4. 180° INSTRUMENT TURN	8. LANDING

FIGURE 4.--MEAN PERCENT ERROR BY CONTACT PPDR MANEUVER.

student in each group who completed the instrument training passed the instrument checkride in accord with FAA standards in the same manner as regular E-RAU students.

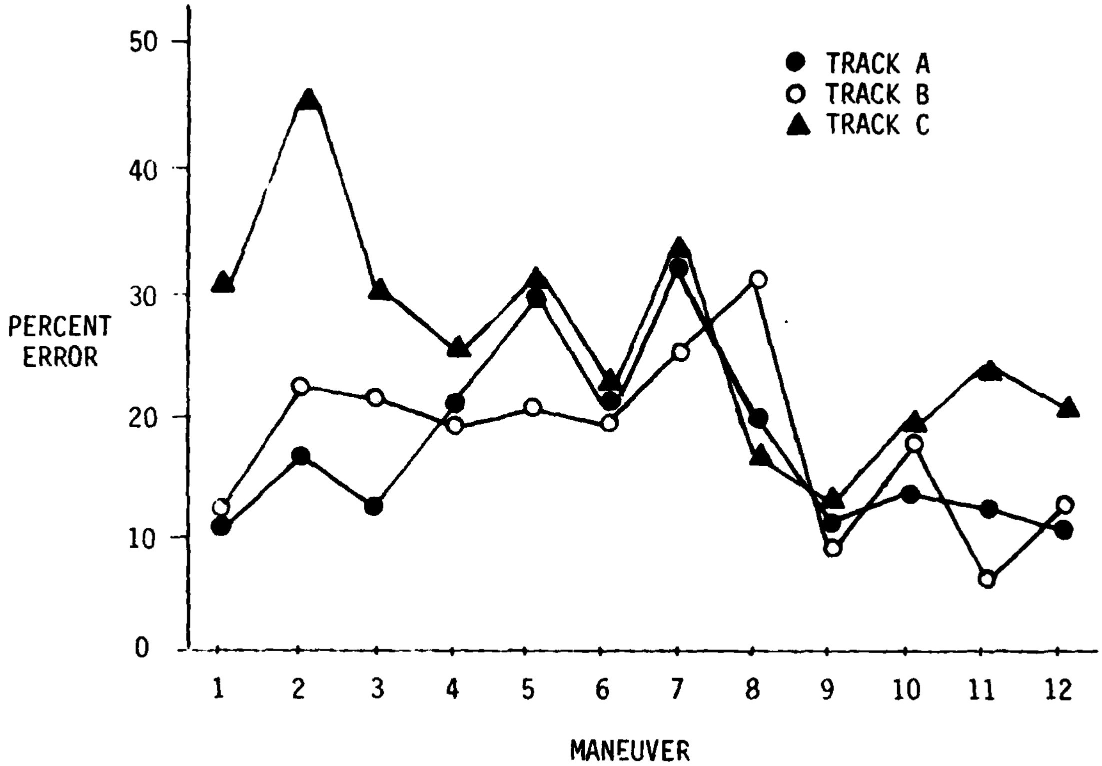
TABLE 4.--MEANS (M) AND STANDARD DEVIATIONS (SD) OF SCORES ON INSTRUMENT CHECKRIDE

Track	N	PPDR Total % Error		Average Maneuver Grade	
		M	SD	M	SD
A	27	17.88	13.32	2.10	.67
B	26	17.66	11.25	2.29	.71
C	26	23.79	8.35	1.83	.55

A one-way ANOVA for the mean letter grades, scaled as described previously for each group, resulted in a statistically significant difference. The F was 3.37, which is slightly higher than 3.12, the value for the .05 level with 2 and 76 df. The Fmax of 1.66 for standard deviations did not approach significance, however. As with contact checkride performance, Track C, which had the greatest amount of flight time prior to instrument training, had the highest error rate. Thus, the reduction in previous flight time for Tracks A and B had no adverse effect on their performance as represented by mean maneuver grades.

Mean PPDR performances by the separate tracks on each of the 12 instrument maneuvers are shown in Figure 5. The patterns from maneuver to maneuver are quite similar, but it can be seen that the higher overall error rate for Track C was due mainly to relatively poorer performance on the first three maneuvers (Straight and Level, Magnetic Compass Turn, and Slow Flight) of the Instrument PPDR and, to a lesser extent, on the last two maneuvers (Emergency Procedures and Unusual Attitude Recovery).

As with the contact checkride, grades on the four flight quality categories were analyzed by an ANOVA for multiple observations on the same subjects. These categories differ from those for the contact checkride only in that Communication Procedures replaced Collision Avoidance. A summary of the analysis appears in Table 5. The Fs of particular interest are those for Track and for the Track by Quality interaction because they can reveal track differences. Both were significant at the .05 level. An F of 3.12 was required for the track significance, and 2.14 for the interaction. The obtained Fs were 3.86 and 2.56, respectively. The separate means are plotted in Figure 6. It is apparent that the significant F for track differences is due primarily to the mean grades of Track C being consistently below (i.e., poorer than) the means for Tracks A and B. Also, the interaction is due primarily to the relative superiority of Track B on Flight Safety, and the greater inferiority of Track C on Communication Procedures. As with the objective data from the



1. STRAIGHT AND LEVEL
2. MAGNETIC COMPASS TURN
3. SLOW FLIGHT
4. VOR
5. ADF
6. ILS
7. HOLDING
8. PROCEDURE TURN
9. CROSS-COUNTRY
10. RADAR VECTORS
11. EMERGENCY PROCEDURES
12. UNUSUAL ATTITUDE RECOVERY

FIGURE 5.--MEAN PERCENT ERROR BY INSTRUMENT PPDR MANEUVER.

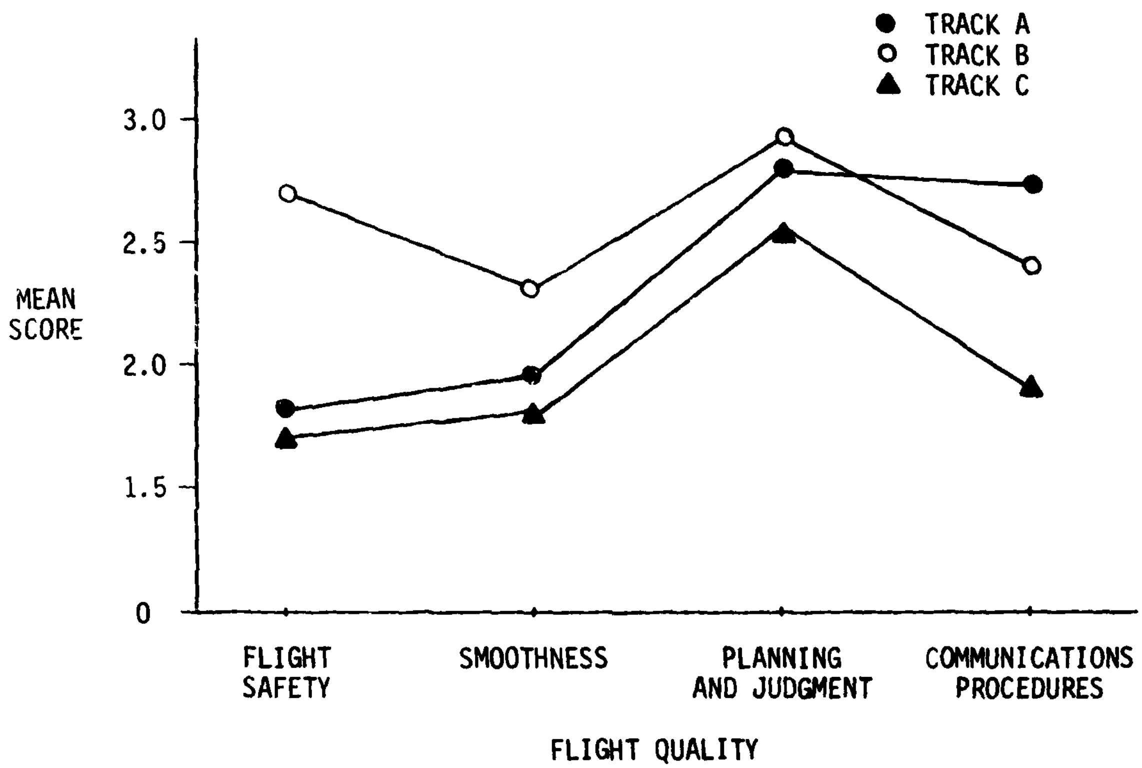


FIGURE 6.--MEAN FLIGHT QUALITY SCORES FOR INSTRUMENT CHECKRIDE.

Instrument PPDR, the grades assigned by checkpilots also clearly support the interpretation that lesser amounts of prior flight time had no adverse effect on instrument checkride performance.

TABLE 5.--SUMMARY OF THE ANOVA FOR GRADES ON INSTRUMENT CHECKRIDE FLIGHT QUALITIES

Source	df	Mean Square	F	p
Between subjects				
Track (T)	2	10.83	3.86	<.05
Between error	75	2.809		
Within subjects				
Quality (Q)	3	7.880	11.35	<.001
T x Q	6	1.775	2.56	<.05
Within error	225	0.6943		

Note: Data for one student who was nearest the average for all measures were eliminated from Track A so as to equate numbers of subjects across groups.

DAILY PROGRESS RECORD.

As pointed out in Section II, meaningful analyses of DPR data could not be made because the data often were neither comparable across students nor from day to day for a given student. Summaries of these data are presented in Appendix I, nevertheless. In viewing them, it should be recalled that tasks practiced on the later days more likely emphasized skills needing improvement, thus slighting skills that had been learned well. As a result, errors shown for later practice periods are probably disproportionately high. Also, these curves do not show the rapid initial drop in errors characteristic of most learning curves of this nature. The reason is likely that these students had already gained considerable mastery of basic flight skills at the time they entered instrument training. Therefore, the period of rapid error reduction characteristic of classical learning curves had ended before these DPR data were collected.

Although factors related to the recording of DPR data prevent a direct inspection of bases for differences in early stages of learning, the early differences may relate to prior flight experience. Even so, the maneuver curves that extend to 10 or more trials, when plotted for all three tracks on one graph, usually converge toward the end of instrument training. In other

words, any differences among tracks in early training decreased over time with the result that differences essentially disappeared by the end of training. This is as would be expected in an individualized training program in which training is varied as befits the individual student's needs in achieving the specified terminal training objectives or performance levels that define the goals of training.

TRAINING TIME.

Another aspect of the instrument training should be noted. While the results described have shown no significant differences in the flight performance of the three groups at the end of their instrument training, the DPR data just mentioned suggest the possibility of some differences during the acquisition of instrument skills by the three tracks. Another index of such "process" differences[1] is the amount of time taken by the students to complete the requirements of their instrument training.

As can be derived from the instrument training entry and exit times previously given for the three training tracks, Track A received a mean of 46.6 instrument training hours, Track B 38.5 hours, and Track C 41.2 hours. Analysis of variance for these times yielded an F of 9.76 which, for 2 and 76 df, is significant at the .001 level. Thus, the least experienced group (Track A) received somewhat more instrument instruction to meet the course requirements than did the other two tracks. It is noted, though, that the least amount of instrument instruction was received by the intermediate experience level group (B). Nevertheless, in spite of these process differences, the outcome of such training was a level of instrument flight performance that was not significantly different among the three track groups; all subjects in all three groups met the same standards of performance as do students in the regular Commercial Pilot Course, i.e., passing the instrument checkride in accord with FAA standards.

It is obvious, of course, that there are many process differences from one training program to another in general aviation as to how the required skills are produced. However, the requirement that all students meet the common performance criteria as defined by FAA flight test requirements is intended as the quality assurance mechanism for differing flight programs. Thus, the emphasis by FAA on outcome measures of performance, i.e., checkride performance, and standardized criteria seems fitting. Such emphasis also characterizes the present study.

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[1] In the evaluation of education and training programs, the terms "process measure" and "product" or "outcome measure" have come into widespread use. In the present context, indices resulting from the instrument check are the "product" measures, while those relating to the instrument training program itself--e.g., the DPR data and instrument training times--are the "process" measures.

IV. DISCUSSION AND CONCLUSIONS

The present study was performed to determine whether level of pilot experience, as represented by three different amounts of total flight time, affects the ability to acquire and demonstrate instrument flight skills. The finding was that total flight time, within the range examined, had no effect insofar as outcome measures obtained during the instrument checkride are concerned. In fact, observed instrument performance differences slightly favored students with the lesser amounts of experience (113 or 138 hours) over those with the greatest amount of flight experience (171 hours). The maneuvers included in the Instrument PPDR, and the 98 specific measures of performance on them, encompassed not only the critical indicators of instrument flight skills, but also the aspects of aircraft control required for safe operation in controlled airspace.

It would appear, on the basis of these data, that factors other than prior flight time should be considered in defining criteria for the instrument rating. This conclusion is supported not only by the data reported here, but by post-study discussions with checkpilots and instructors and by review of the research literature on instrument and contact flight training (Appendix A).

The 200-hour requirement has been assumed to promote operational safety. Prior to this study, however, justification for the requirement has not been examined empirically. While it is true that proficiency generally tends to improve with experience, it must be remembered that errors in judgment or decision making continue to occur among pilots with thousands of hours of total flight time. But, it must also be remembered that errors in judgment or decision making, along with inadvertent circumstantial occurrences, result in significant numbers of low experience pilots being placed in instrument flight situations with which they are ill equipped by their training to cope, often with fatal results. Thus, given that total flight hours is not an adequate guide for defining the point at which the rating of instrument capability should be awarded, the important operational question concerns possible alternatives to the rigid 200-hour requirement.

Perhaps the most reasonable alternative would consist of more careful definitions of the minimum skills and knowledge required to operate safely under instrument meteorological conditions, in conjunction with the development of performance standards and objective measurement procedures to determine that the skills and knowledge have been attained. Therefore, a systematic effort to identify requisite skills and standards for their assessment, and to develop performance measurement methods encompassing these standards, appears necessary if general aviation training and rating/certification requirements are to be optimized.

The development and implementation of explicit flight proficiency standards would ensure that applicants for all certificates and ratings (not just the instrument rating) would be sufficiently skilled to operate safely in the National Airspace System. It is evident from the safety data discussed in the first section of this report that the numbers of fatal, weather-related accidents among low-time pilots are excessive. A more direct approach to the

skills required to handle instrument flight situations among such pilots would seem in order. Experience is important, but the present results suggest it is the content of such experience and not its amount that is of primary concern.

The paramount question, then, seems to be whether adequate performance standards can be generated, adopted nationally, and employed consistently by all flight proficiency evaluation personnel as a replacement for the 200-hour experience requirement. The 200-hour requirement has for the past forty years functioned as a de facto substitute for such standards, but, as noted, the accident data raise serious questions as to its effectiveness. More specific and pertinent criteria for evaluating the complex skills required for safe aircraft operation in instrument meteorological conditions seem required.

CONCLUSIONS.

1. Within the ranges of pre-instrument flight experience examined in this study and for the subject population used, amount of prior flight time had no effect on the acquisition and demonstration of instrument flight proficiency.

2. Consideration should be given to extending the results of this study to other populations and to reducing the present 200-hour experience requirement for issuance of an instrument rating as a means of encouraging earlier training of instrument skills.

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APPENDIX A

PAST RESEARCH ON INTEGRATED TRAINING

INTEGRATED TRAINING.

There is a sizeable body of literature on the acquisition and retention of contact and instrument flight skills. A review of this literature revealed twelve previous empirical studies bearing on the feasibility of early instrument training. These studies were all concerned directly or indirectly with the introduction of instrument flying early in the training process. Some form of such training, termed integrated training when combined with contact training, would appear to offer the greatest potential for eliminating the current operational problem described in the body of this report. These studies were considered relevant to the present effort because of their treatment of content, format, and sequence of contact and instrument training and their implications concerning effects of such training upon pilot proficiency. Following are brief synopses of several of the studies that are especially relevant to present purposes.

CIVIL AVIATION RESEARCH ON INTEGRATED TRAINING. The first reported attempt to integrate contact and instrument training was made by Lee (1935) at the Boeing School of Aeronautics. He trained 16 students solely by reference to instruments during their first 23 hours of training. This was followed by contact training and later by a combination of the two. Results, although subjectively evaluated, were positive and prompted Lee to conclude that students enrolled in long-term flight training courses should begin instruction under the hood. However, the study employed no control groups, used highly impressionistic assessments of student performance, and failed to integrate contact and instrument skills at the start of training.

Two decades elapsed before further work in this area was reported, at which time Ritchie and Michael (1955) examined the transfer effects of instrument-to-contact training, and of contact-to-instrument training. Groups of students with no flight experience were trained either on instruments followed by contact or on contact followed by instruments. There were 11 students in each group. Relatively objective measures of performance were obtained on two maneuvers--straight and level flight and 180° turns. Upon attainment of criterion performance on both maneuvers by one method, students commenced training on these same maneuvers by the other method. More trials were required to learn instruments than contact. Of greater significance, however, was the finding that contact and instrument flying had very different transfer effects upon each other. Specifically, contact-trained subjects demonstrated a negative 22% transfer effect on learning instruments, while instrument-trained subjects showed a positive 47% transfer effect on learning contact. Ritchie and Michael concluded that the difference in the direction of transfer

might be expected to reduce the overall learning time for both forms of training when instrument skills are trained before contact. They further indicated that the traditional approach to flight training has been at least wasteful of training efforts, and may have led "a whole generation" of pilots to hate instruments because instrument flight introduces actions that compete with strongly-established contact habits.

A later study by Ritchie and Hanes (1964), using a greater number of subjects, partially replicated the finding of Ritchie and Michael (1955). Transfer from instrument to contact training was again found to be positive. However, non-significant positive transfer effects from contact to instrument learning also were observed. Not surprisingly, significantly fewer trials (61%) were required to learn contact than instrument flying, a result suggested by the earlier study. This finding led the investigators to conclude that instrument flying is reliably more difficult to learn than contact flying.

A methodological weakness in these studies was the selection of only two basic tasks (straight and level flight and 180° turn maneuvers) on which to obtain performance measures. There is a question as to whether findings related only to these tasks can be generalized to all the interactive cognitive, procedural, decisional, and psychomotor skills required for general operation of aircraft. There is a need for a more representative range of flight tasks before such generalizations can be made reliably.

A study conducted by Williams, Houston, and Wilkerson (1956) at the University of Illinois Institute of Aviation addressed the feasibility of incorporating both instrument and contact flight training within the scope of the private pilot syllabus. The first 3.2 hours of training were spent either in a ground trainer or under the hood in the aircraft. Contact flying was then introduced and interspersed with instrument flying thereafter. All the subjects passed the private pilot checkride and, by means of subjective evaluations, showed substantial ability to engage in basic instrument flight. Williams et al. noted that the integrated format did not hamper students' contact proficiency, that they were enthusiastic about instrument flying and motivated to learn more about it, and that a few of the students were able to pass the basic airwork portion of a standard instrument checkride. The flight instructors who served in the project felt that the integrated contact/instrument concept should be incorporated into all private pilot training programs.

Seltzer (1958), at West Virginia University, conducted a study with ten subjects to determine whether they could be trained effectively as private pilots in a course combining instrument and contact flight training. All subjects passed the private checkride after training times not appreciably greater than students normally required at that school. Of the ten experimental subjects, two participated in another 20 hours of instrument training after which they took standard instrument checkrides.[1] One of the students passed the flight

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[1] These students did not meet the experience and training requirements as prescribed by the FAA for the instrument rating. As described in this report, those requirements include 200 hours of total flight time and 40 hours of instrument time under actual or simulated conditions. These two students had approximately 65 total flight hours and 25 instrument hours upon taking their instrument flight check.

check. The FAA examiner who administered the ride noted that this student was an example of what can be accomplished with carefully controlled training, high instructor proficiency, and able students. The other student failed the checkride, but his examiner indicated that a few more hours of training would likely bring him up to full instrument standards. Seltzer concluded that some instrument training should be included in the initial phases of flight instruction since such training appears to facilitate both contact and instrument skill acquisition.

Another study was conducted by Seltzer the following year (Seltzer, 1959) to determine whether a relationship existed between the amount of contact flying experience of general aviation pilots and the amount of instrument instruction required to develop minimally acceptable instrument proficiency. Sixty-six qualified private pilots from two states were used as subjects. A five-point subjective grade scale was used and the content and sequence of instrument flight checks were standardized. Seltzer found no relationship between previous contact experience and the learning of instrument flight skills.

A study was performed at Ohio State University to determine the effects of an integrated VFR-IFR curriculum on both contact and instrument flying skills (Easter & Hubbard, 1968). The integrated curriculum consisted of 75 total flight hours. All maneuvers were introduced using instrument references, with the relationships between them and visual references emphasized. Performance of the experimental students receiving this integrated training was compared statistically to that of private pilot and instrument pilot control groups at various points during the training sequence. Both objective and attitudinal data indicated a difference slightly in favor of the experimental group with regard to contact flying skills. However, instrument skills of the experimental group were found to be markedly inferior to those of the instrument control group.[1] It was concluded that 75 hours of flight time was insufficient to train the "judgment, self-reliance, and seasoning" necessary to operate IFR in the complex ATC network. It was not possible, however, to identify in the data obtained the variable(s) responsible for these instrument skill deficiencies. The authors presented several cogent interpretations of their results, including the lack of sufficient solo cross-country time by the experimental group, possible instructor recording differences, and a lack of sufficient training time and content relative to the complex time-shared aspects of instrument flying.

Like most of the work preceding it, the design of the Easter and Hubbard (1968) study permitted neither definitive explanations concerning why significant differences were obtained, nor reliable estimates of additional time necessary to bring the experimental group up to FAA instrument rating standards. The present study attempted to overcome some of the methodological deficiencies of past attempts. It was recognized, however, that many such deficiencies are inherent in attempts to gather performance data of this nature within operational settings.

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[1]The instrument control group consisted of 15 students whose mean total flight time at the beginning of the project was 367 hours, a confounding variable as reported by the authors because the experimental subjects began training with zero prior flight hours.

MILITARY AVIATION RESEARCH ON INTEGRATED TRAINING. All three branches of the military have investigated some form of early integrated contact/instrument training. While there remains some controversy as to how much and what type of instrument training is sufficient to produce combat-ready aviators, there has been a definite trend toward introducing instrument skills very early in the training sequence and reinforcing the use of those skills by student pilots throughout training.

The Air Force, through its Primary Flight Training Research Unit (1957), conducted an experiment at Graham AFB, Marianna, Florida, in 1956-57 for the purpose of evaluating the integrated training concept. Two primary pilot classes were trained using this concept. One class used the block approach, and the other the simultaneous (instrument/contact) cue method. Data consisted of the subjective reports of the participating instructors. While the instructors generally were of the opinion that the simultaneous use of contact and instrument cues resulted in informational overload for the beginning student, the instructors were unanimous in their desire to use the following instructional sequence:

1. Three hours of ground trainer instruction to teach pitch, bank, and power control.

2. Three hours of pitch, bank, and power control instruction in the aircraft under the hood.

3. A contact check to include solo flight.

4. The remainder of training using the simultaneous cueing method.

Overall conclusions based upon subjective flight check data were that integrated training slightly improved primary pilot performance; that the simultaneous cue method is capable of producing a level of proficiency greater than that resulting from the use of conventional methods; and that the use of integrated concepts should be extended into basic (as well as primary) training to promote continuity.

In 1957, the Army Aviation School examined, on a preliminary basis, the feasibility of integrated fixed-wing training. Investigators and training managers were sufficiently optimistic about the results of that study to recommend that a larger-scale assessment of integrated training be conducted. In response to that recommendation, a comprehensive, well controlled study of integrated training was carried out. This study, known as INTACT, was performed in 1960-61 by the Human Resources Research Office (HumRRO) and the results were published by Prophet and Jolley (1969).

The major purposes of INTACT were to determine: (1) contact and instrument proficiency levels of primary flight students trained under an integrated concept relative to those trained using standard methods; (2) rates of attrition for integrated and non-integrated classes; and (3) the extent to which integrated training effects exhibited during the early phases of training would be demonstrated during advanced contact and instrument training.

Three groups of 36 students each received primary flight training under either integrated or non-integrated methods. The performance of these students was compared throughout and at the completion of training using objective measures. Other proficiency measures employed in this study were attrition, training time, and subjective checkride grades.

Results indicated no significant performance differences among groups using any of the objective measures at any point during either primary or advanced training. The subjective numerical checkride grades were significantly higher ($p < .05$) for integrated groups than non-integrated groups during primary training. No significant differences were obtained for advanced phases. Conclusions were that integrated primary flight training produces advantages in primary flight proficiency but that those advantages are not manifest in advanced flight performance.

The overall body of research data concerned with integrated training suggests that it might be possible--even likely--that private pilots can learn instrument skills that meet minimum required proficiency levels in fewer than 200 hours total flight time.

APPENDIX B

MISCELLANEOUS DATA FOR SUBJECTS

The data in this appendix are only for subjects who completed the experiment. The data include: (1) sex of subject; (2) age at the beginning of training; (3) grade point average (GPA) for E-RAU courses 102, 103, and 203; (4) scores on the Private Written Examination administered just before the contact checkride; (5) total training hours when exiting from instrument training; (6) pilot-in-command time up to the instrument checkride; and cross-country time up to the instrument checkride.

TRACK A SUBJECTS

Subject No.	Sex	Age	GPA	Private Written Score	Instrument Training Exit Hours	Pilot-in-Command Time	Cross-Country Time
1	F	22	3.0	82	110	32	15
2	M	23	3.1	92	115	34	17
3	M	19	2.5	85	112	34	18
4	M	20	3.0	86	117	33	13
5	M	19	2.5	85	118	35	15
6	F	20	3.2	80	115	32	12
7	M	19	2.1	77	120	35	12
8	M	20	2.7	78	113	31	20
9	M	20	2.7	78	117	30	17
10	M	21	2.7	85	107	32	15
11	F	24	3.9	78	139	35	25
12	M	20	3.0	79	108	30	11
13	M	20	1.9	73	115	40	16
14	M	19	3.4	92	107	31	10
15	M	20	3.3	88	122	34	13
16	M	23	2.8	86	105	31	20
17	M	21	2.0	83	109	30	15
18	M	20	3.2	86	100	41	20
19	M	20	2.6	90	110	40	21
20	M	19	2.7	87	110	38	18
21	M	21	2.8	79	115	41	15
22	M	27	3.1	92	112	37	15
23	M	22	2.8	85	108	31	21
24	M	21	2.5	78	117	32	15
25	M	19	3.7	95	120	25	16
26	M	20	2.3	88	113	40	20
27	M	26	2.3	70	114	35	21
Mean	(11.1% Female)	20.93	2.81	83.59	113.63	34.04	16.52
Standard Deviation		2.09	0.48	6.15	7.16	4.00	3.62

TRACK B SUBJECTS

Subject No.	Sex	Age	GPA	Private Written Score	Instrument Training Exit Hours	Pilot-in-Command Time	Cross-Country Time
1	M	20	2.8	76	128	70	30
2	M	20	3.8	95	142	75	35
3	M	20	2.2	92	145	92	40
4	M	24	2.9	82	135	70	40
5	M	19	2.2	76	137	70	40
6	M	19	2.5	77	140	75	38
7	M	19	2.1	75	135	74	41
8	F	19	2.8	90	145	82	39
9	M	22	2.7	75	137	80	40
10	M	19	3.0	70	130	70	42
11	M	21	2.0	83	146	91	45
12	M	19	3.6	88	131	71	43
13	F	23	3.5	76	137	73	39
14	M	19	2.4	75	145	90	45
15	M	19	3.3	80	130	72	40
16	M	21	2.0	79	138	83	42
17	M	19	2.9	75	142	90	45
18	M	20	2.4	85	140	68	43
19	M	21	2.2	72	125	79	43
20	M	19	3.4	93	150	70	40
21	M	20	2.3	81	139	82	38
22	M	22	3.2	78	137	75	42
23	F	20	3.2	88	142	74	42
24	M	19	3.1	80	139	73	37
25	M	22	3.6	97	140	83	41
26	M	19	2.9	92	145	86	43
Mean	(11.5% Female)	20.15	2.81	81.92	138.46	77.62	40.50
Standard Deviation		1.43	0.54	7.66	6.09	7.52	3.26

TRACK C SUBJECTS

Subject No.	Sex	Age	GPA	Private Written Score	Instrument Training Exit Hours	Pilot-in-Command Time	Cross-Country Time
1	M	20	2.9	78	183	70	41
2	M	23	2.6	92	180	50	35
3	M	20	2.5	74	164	100	45
4	M	20	2.5	81	162	70	50
5	M	25	2.6	78	183	90	65
6	M	20	2.0	87	166	70	40
7	M	19	2.6	78	169	60	45
8	M	22	3.3	78	168	60	40
9	M	21	3.5	97	175	60	45
10	M	20	2.5	77	170	70	45
11	M	26	3.4	86	175	85	35
12	M	19	2.1	77	160	75	35
13	M	21	1.9	70	162	90	41
14	F	20	1.8	75	177	80	35
15	M	19	2.1	70	169	85	42
16	F	19	2.0	78	165	75	45
17	F	19	2.3	82	168	68	45
18	M	21	2.9	92	167	60	35
19	M	20	2.2	78	172	70	30
20	M	21	2.2	75	163	85	50
21	M	21	2.4	87	162	60	40
22	M	23	2.2	80	176	68	42
23	M	19	2.0	70	177	70	41
24	M	19	2.3	78	178	65	40
25	F	20	1.8	75	181	73	43
26	M	19	2.0	73	180	72	38
Mean	(15.4% Female)	20.62	2.41	79.46	171.23	72.35	41.85
Standard Deviation		1.86	0.47	6.97	7.23	11.54	6.74

APPENDIX C

STATISTICAL ANALYSIS PROCEDURES

In presenting data in this report, several types of statistics are used. To summarize the general nature or typical value for a group of measures, descriptive statistics such as the Arithmetic Mean (M) and Standard Deviation (SD) are used. The M is that statistic which is commonly referred to as "the average," while the SD is an indicator of the degree of variability among individual measures about the group M value.

In evaluating whether two or more sets of data (e.g., Groups A, B, and C) differ to a degree greater than might be expected by chance, various statistical significance tests are used. In the present report, these are the "chi squared" test and the "analysis of variance (ANOVA)."

Degree of departure from chance expectation is expressed in terms of probability statements. For example, the expression $p < .05$ means that the probability is less than 5 in 100 that the difference is due to chance alone; $p < .01$ means that the probability is less than 1 in 100; etc. Thus, the smaller the probability figure, the more significant a difference is and the less likely it is due to chance variation. In keeping with statistical convention, differences are not considered statistically significant here unless the probability is 5 in 100 or less.

The ANOVA test yields a statistic called the F ratio, which is the ratio of two variance estimates, and it is this F statistic that allows the probability determination. Similarly, the chi squared test yields a statistic that permits a probability determination of the significance of a difference. In both the ANOVA and chi squared tests, reference is made to df, or degrees of freedom. The df refers basically to the number of independent measures on which the test is based.

The reader desiring more information of such statistical analysis and test procedures is referred to any one of the large number of standard statistical textbooks available. For example, see:

Edwards, A. L. Statistical analysis. New York: Holt, Rinehart, & Winston, 1974.

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APPENDIX D

PILOT PERFORMANCE DESCRIPTION RECORD (PPDR) FOR THE CONTACT CHECKRIDE

This appendix presents materials for the Contact Checkride PPDR as they were adapted for the present experiment. Four items are included. First, the Handbook, which begins on page D-2, describes the PPDR and gives instructions for its use. Second, performance measure definitions and guidelines for recording data begin on page D-7. Third, the syllabus for training the checkpilots to use the PPDR is outlined, beginning on page D-11. Fourth, the PPDR forms used for recording begin on page D-15.

Pilot Performance Description Record (PPDR)

I. Purpose

A. General - to provide a method of clearly describing and documenting student pilot performance

B. Specific - to provide objective performance data for evaluating Contact performance of students in various training tracks.

II. Guiding Principles

A. to obtain a maximum of descriptive and specific judgmental information with a minimum of inflight marking

B. to be made compatible with existing FAA and E-RAU checkride procedures

C. to provide a snapshot sample of student performance of those flying skills required to pass the Private Pilot Checkride.

III. PPDR Characteristics and General Utilization

A. Each flight maneuver in this PPDR has been analyzed and discussed with E-RAU personnel to determine its fundamental components. The analyses provided the basis for the development of descriptive and judgmental scales on which each performance component, such as direction, attitude, power, and flight path, could be quickly described by the checkpilot.

B. This PPDR includes a sample of the maneuvers described in the FAA flight test guide on which proficiency must be demonstrated to pass the checkride for the Private Pilot license. This PPDR is intended to provide descriptive data for this maneuver sample only, and as such, it should be viewed as a part of the checkride and not as a substitute for the more comprehensive set of checkride maneuvers prescribed by the checkpilot. Administration of this PPDR should not restrict or constrain the checkpilot's usual checkride prerogatives. In particular, inflight safety must not be jeopardized. Although the sequence of PPDR maneuvers should be standardized as described in E. below, it is recognized that these PPDR maneuvers will be interspersed throughout other checkride maneuvers. The performance description resulting from this PPDR is considered to be as complete as can be obtained efficiently by manual recording during a single flight period.

C. In any data collection effort, reliability (meaning consistency or repeatability of test result), and validity (meaning measurement of that which is intended to be measured) are desirable goals. One necessary factor in achieving high levels of reliability and validity is standardization of the test sample, test conditions, and methods of data recording. The standardization of the flight test sample and the methods for administering and evaluating it is the aim of the PPDR.

D. This PPDR is separated into the eight major maneuvers to be recorded. Each maneuver is divided into segments that specify observations that are to be made as objectively as possible. During a flight check, student performance normally is recorded during or near the end of each maneuver segment, provided that performance is within the limits specified as "proper" on all scales in that segment. Whenever an error exceeding "proper limits" of a scale occurs, the checkpilot should record it immediately, regardless of how much of the segment is completed. If, later in the segment, the student exceeds his previous error on the same scale, the checkpilot makes a second mark farther out on the scale. Generally speaking, erratic performance is reflected by multiple marking; for example, if the descent rate during an approach is uneven, both "slow" and "fast" may be marked.

E. There are three general levels of detail represented in the PPDR: (1) individual performance measures, (2) flight segments, and (3) maneuvers. Segments and measures are listed in the approximate sequence in which they occur during execution of the maneuver. This is intended to simplify and standardize inflight data recording.

Individual Performance Measures. The PPDR measuring scales show the detailed and descriptive criteria of student performance which underlie the evaluation made by the checkpilot. Examples of these scales are RPM, airspeed, altitude, and ground track. These scales are recorded objectively by the checkpilot from instruments or clearly definable outside references. However, it is not always possible to find such outside references for certain crucial aspects of student performance. Consequently, a few scales are judgmental in nature, e.g., pattern exit or control smoothness. The checkpilot must use his judgment in evaluating and recording these items.

Flight Segments. The subdivision of each PPDR flight maneuver into its segments is indicated by single horizontal lines between segments. The segment breaks serve to remind the checkpilot of the time required for that particular group of measures. More importantly, they make it easier for the checkpilot to focus on a particular group of measures for the specific portion of flight performance being recorded. This reduces the difficulty in determining the flight performance sample to which each measure applies. Occasionally, a measure refers only to a specific part (beginning or end) of a segment; but these instances will be obvious to the checkpilot. Segments and measures are sequenced from the top of the page to the bottom.

Maneuvers. There are several factors about the selected flight maneuvers that the PPDR seeks to control. One factor is the specification of performance measures and segments within maneuvers. The PPDR also requires that all students perform identical maneuvers, which ensures that the same behavioral patterns are sampled in all students. Because the sequence in which maneuvers are given during a flight check can affect the results, the sequence for the eight PPDR maneuvers has been standardized. The sequence which has been settled upon should allow for maximum use of available time and resources. Due to the requirement for economy of time and effort in conducting the checkride, the maneuver performance sequence may be varied somewhat to expedite or to increase its efficiency or convenience. However, this standardized sequence should be followed as closely as possible. All maneuvers must be completed for each checkride. The recommended sequence for the eight PPDR maneuvers is:

1. Short Field Takeoff
2. Approach Stall Recovery
3. Slow Flight
4. 180° Instrument Turn
5. VOR Procedures
6. Turns About A Point
7. Traffic Pattern
8. Soft Field Landing

F. PPDR reliability is dependent upon the degree of standardization achieved in administering checkrides. It is essential that every checkpilot thoroughly understand each measure in this PPDR as described in this appendix. In addition to knowing the measure definitions, it is important that the checkpilot clearly understand that he has two roles, evaluator and recorder. In his normal role as evaluator, the checkpilot observes student performance throughout the entire checkride, and renders his assessment of the efficacy of issuing a Private Pilot license on the basis of the proficiency that he observes. As a recorder, he is asked to provide accurate and descriptive information on the observed performance as it occurs and upon which his evaluation is ultimately based. The recording function is thus extremely critical to the PPDR data collection effort. To achieve the goal of accuracy and completeness of recording, the student's performance should be recorded as soon after it occurs as is practical, with due consideration for safety.

G. The checkpilot should maintain an impartial attitude toward the student, limiting conversation to explaining checkride requirements and conditions.

H. The student pilot should not be given detailed feedback relative to checkride performance prior to debriefing.

I. Measures included in this PPDR are of two types:

1. Performance Scales with a desired range of values indicated by a triangular symbol at the scale midpoint, and errors (e.g., left/right) to either side of the triangle. For some measures a desired value is specified at the top of the triangle. Other measures include a '0' above the triangle, indicating that the checkpilot must determine the correct desired value depending upon the aircraft, airspace, or prevailing conditions.

2. Categorical Measures (yes or no) requiring the checkpilot to determine whether or not the observed performance is within acceptable limits. This determination involves more complex judgment for some measures (e.g., constant turn radius) than others (e.g., full throttle).

J. For the scale measures that include a specified deviation range (i.e., tolerance) around the midpoint, the tolerance band specified may or may not be identical to the standards given in the FAA flight test guide. These bands are not necessarily intended to denote FAA acceptable performance, but rather to generate accurate data to document observable performance differences.

K. This version of the PPDR is not intended for use in diagnosing student performance deficiencies. However, research has shown that use of the PPDR can lead to such diagnosis by providing instructors and training managers with a valid and reliable performance data base describing typical and atypical student performance. These data may then be used as an index of comparison (norm) for any given student's observed performance, and therefore provide effective performance feedback to that student.

IV. PPDR Data Recording

A. The cover page of the PPDR is divided into three parts. Part One contains descriptive information about the student, checkpilot, aircraft, etc. and should be completed in its entirety prior to the checkride. Part Two contains weather data. The direction and velocity of crosswind as well as existing turbulence should be recorded both before and after the checkride. Part Three includes four subjective measures of pilot skill. Each measure should be slash marked with the E-RAU grade which, in the judgment of the checkpilot, best describes the overall checkride performance of the student on that factor.

B. Each scale should be marked with at least one slash mark of approximately 1/4 inch in length. The mark should pass clearly and evenly through the scale such that there is no doubt about which scale or which portion of the scale the checkpilot intended to mark. Categorical measures should include a slash mark in the appropriate box.

C. For those segments encompassing an extended period of time (e.g., climbout and pattern exit after takeoff), multiple marks will likely be necessary. This gives a record of deviations as they are observed without forcing the checkpilot to rely upon his memory of an extended performance segment. Errors observed in both directions (e.g., low and high) should be appropriately recorded. Short term segments (e.g., flare) should include only one mark for each measure. Requirement for multiple marking should be apparent to checkpilots.

D. If dangerous performance occurs, the checkpilot should write a letter "D" in the left margin and draw a line to the scale(s) reflecting the dangerous performance. If a maneuver is aborted because of student-induced dangerous performance, an additional notation should be made in the margin and all remaining measures on that maneuver marked in error.

E. If the checkpilot finds it necessary to assist the student with a maneuver, "CP Assist" should be noted in the margin for the affected portion of the maneuver or segment.

F. Go-arounds and their reason should be noted in the margin. When a go-around is initiated for any reason, the checkpilot shall note the go-around point on the PPDR, allow one additional approach, and begin marking at the point of go-around. If erratic student performance necessitates a second go-around, all remaining PPDR measures shall be marked in error, and PPDR recording shall terminate. If the go-arounds are, in the judgment of the checkpilot, weather or traffic-induced, a notation to that effect should be made in the margin, and remaining measures left unmarked.

G. The checkpilot should mark the appropriate E-RAU grade for each PPDR maneuver, and write any additional comments that he deems pertinent to the recorded performance data in the spaces provided at the bottom of each maneuver form. He may also write to the side of or directly above measures or segments, time and space permitting.

Contact PPDR

Performance Measure Definitions and Recording Guidelines

The PPDR provides a record of what actually occurs during the checkride. The maneuvers included in this PPDR are intended to be performed under normal Private Pilot checkride conditions (i.e., no more than light to moderate wind and turbulence effects). As such, the PPDR maneuvers should not be deliberately assigned under extremely windy or turbulent conditions. However, if it is necessary to administer the PPDR in such conditions, an accurate recording of the characteristics of those conditions before and after the checkride will enable them to be considered in the overall analysis of performance. The checkpilot must not allow extraneous factors to influence his marking of the actual performance scales.

Measures are of two general types. One is a scale with a triangle (▲) provided at its midpoint. The triangle should be marked if performance is within non-error limits (i.e., proper). Otherwise, deviations from these limits should be marked in the appropriate error direction (e.g., low or high). Recording should not attempt to reflect the exact number of units of deviation from the midpoint (e.g., 7 Kts. should be marked at any point between 5 and 10 Kts.)

The other measure is categorical, requiring the checkpilot to mark either "yes" or "no" depending on whether the observed performance relative to that measure was, in his judgment, acceptable. Measure definitions should be followed in this determination.

A Grade/Comment section is included at the end of each maneuver. Here the checkpilot should enter the E-RAU grade (A, B, C, D, F) that best describes the overall quality of the maneuver performance recorded in the PPDR, and write any comments that he feels are pertinent to the performance. He may also write to the side of or directly above measures or segments, time and space permitting.

Performance Measures

Abeam Midpoint - On traffic pattern entry, mark "Yes" if entry is, within an acceptable range, made abeam the midpoint of the runway; otherwise, mark "No."

Acceptable Rotation - If rotation is acceptable, mark "Yes"; otherwise, mark "No."

Airspeed - If observed airspeed is within ± 5 knots of the desired airspeed, proper should be marked; otherwise the direction and magnitude of error should be marked.

Altitude - If observed altitude is within ± 50 feet of desired altitude, mark proper; otherwise, mark direction and magnitude of error.

Altitude Loss Acceptable - A measure of stall recovery skill, mark "Yes" if altitude loss during recovery is not excessive; if altitude loss is judged excessive, mark "No."

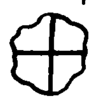
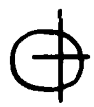
Angle (45°) - Traffic pattern entry track angle should be marked "Yes" if entry is made at approximately a 45° angle; otherwise, mark "No."

Approach Angle - If the approach to landing is judged to be within approximate range of the desired approach angle, mark proper; otherwise, mark whether the angle is too "shallow" or too "steep."

Bank - When turning, if the desired bank angle is maintained within ±5°, proper should be marked; otherwise, the direction and magnitude of error should be marked.

CARB HEAT OFF - Mark "Yes" or "No" as appropriate.

Cockpit Check - If all required cockpit procedures are satisfactorily performed, mark "Yes"; otherwise mark "No."

Constant Radius Turn - A measure of wind drift correction in turns about a point, mark "Yes" if the turn radius is approximately equal throughout both turns: If the ground path is erratic  or if the turns are smooth but drift corrections are improper,  mark "No."

Contact - Mark proper if landing contact with the runway is correctly timed and smooth; otherwise, mark whether the aircraft was "dropped" or "bounced."

Control Coordination - A measure of general control skill, mark "Yes" if student maintains coordinated flight (± 1 ball) during turn. Otherwise, mark "No."

Degrees Turned - Mark proper if the observed number of degrees turned is within ±5° of the desired number of degrees turned; otherwise, mark the direction and magnitude of error.

Descent Rate - If the observed descent rate is judged to be within approximate range of the desired descent rate, mark proper; otherwise, mark the direction of error ("slow" or "fast").

Distance Out - Mark proper if the traffic pattern is entered at the correct distance from the runway; otherwise, indicate whether entry is "too close" or "too far" from the runway.

Enter Downwind - Mark "Yes" if entry is, within acceptable limits, in a downwind direction; otherwise, mark "No."

Flaps (10°) - Mark "Yes" or "No" as appropriate.

Full Flaps - Mark "Yes" or "No" as appropriate.

Full Throttle - If throttle is full open, mark "Yes"; any throttle setting less than full should be marked "No."

Heading - Mark proper if observed heading is within $\pm 5°$ of desired heading: otherwise, mark direction and magnitude of error.

Level-off Altitude - Traffic pattern or assigned level-off altitude, if achieved within ± 50 feet, should be marked proper; otherwise, the direction and magnitude of error should be marked.

Maintain Airspace Scan - If student scans (with visible head movement) for other aircraft while executing turns about a point, mark "Yes"; otherwise, mark "No."

Mixture, Full Rich - Mark "Yes" or "No" as appropriate.

Pitch Decreased - A component of stall recovery skill, mark "Yes" if pitch is properly and immediately decreased after stall occurs; otherwise, mark "No."

Power, Idle - Mark "Yes" or "No" as appropriate.

Proper Entry Sequence - If all necessary procedures are performed in the correct sequence during entry to slow flight, mark "yes", if any procedure is omitted or out of sequence, mark "No".

Proper Flaps - If the flaps are set in the desired or assigned configuration, mark "Yes"; otherwise, mark "No."

Proper Flare Attitude - Mark proper if the aircraft is in the correct nose-up pitch attitude during the flare; otherwise, mark the direction of error ("nose low" or "nose high").

Proper Flare Rate - Mark proper if the flare rate is within proper limits; otherwise, mark whether the flare was too "slow" or too "fast."

Proper Ground Track - If the aircraft is maintained within an acceptable range of the desired ground track throughout a segment, mark "Yes"; otherwise, mark "No."

Proper Pattern Exit - When exiting the traffic pattern, mark "Yes" if exit is timely, at the proper location, altitude, and correct angle. If any one of these conditions is not satisfied, mark "No."

Proper Recovery Sequence - If all necessary procedures are performed in the correct sequence during recovery from slow flight, mark "Yes"; if any procedure is omitted or out of sequence, mark "No".

Radial Identified - If student can correctly identify radial and orient accordingly, mark "Yes"; otherwise, mark "No."

Reduce Power - If power is reduced within a proper time range, mark proper; otherwise, mark whether power was reduced too "early" or too "late" in the traffic pattern.

RPM - If the desired RPM setting is maintained within ±50 RPM, proper should be marked; otherwise, the direction and magnitude of error should be marked.

Runway Centerline Track - This is a measure of directional control during takeoff and landing ground roll and should be marked proper as long as the runway centerline is within the wing tips. Deviations from centerline ("left" or "right") should be marked if the wingtip opposite the direction of deviation passes the runway centerline.

Smooth Control - If control movements are judged smooth and coordinated for all segments of the maneuver, mark "Yes." If any segment contains control movements that are erratic, of excessively large magnitude or frequency, or otherwise unacceptable, mark "No."

Stall Recognized - Timely and correct recognition of stall should be marked "Yes"; otherwise, mark "No."

Station Identified - If the student can correctly identify the VOR station within an acceptable time period, mark "Yes"; otherwise, mark "No."

Station Tuned Properly - If correct VOR station is correctly tuned within an acceptable time period, mark "Yes"; otherwise, mark "No."

Track from Extended Runway - A measure of track control after liftoff and during approach to landing; proper should be marked if the aircraft track is maintained within an acceptable track width from ground level to an altitude of 500 feet or until a turn is correctly initiated. If, in the checkpilot's judgment, proper track is not maintained during climbout or approach, "left" or "right" should be marked.

Touchdown Point - If the aircraft touches down within an acceptable range of the touchdown point, mark proper; otherwise, mark whether the observed touchdown is short or long relative to the desired or assigned touchdown point range.

Trim - A measure of ability to trim for hands-off flight, mark "Yes" if little or no control is required to maintain level flight; otherwise, mark "No."

Turn to Inbound Heading - If inbound heading is achieved within ±5° of that assigned, mark proper; otherwise, mark the direction and magnitude of error.

Turn Started - A measure of traffic pattern skill, mark proper if the turn is initiated within an acceptable distance of the desired or assigned turning point; otherwise, mark whether the turn was initiated too "early" or too "late."

VOR Track - Mark proper if the CDI needle is maintained within ± one dot of the circle for the duration of the track; otherwise, mark the direction and magnitude of error.

Contact PPDR

E-RAU Checkpilot Training Program

1. Purpose - to describe and explain the purpose, objectives, and correct usage of the Contact PPDR to the E-RAU checkpilots participating in the NAFEC data collection effort.

2. This training program is designed to standardize and qualify the checkpilots in the use of the Contact PPDR.

3. The recommended training sequence should be followed as closely as possible in training the checkpilots in the use of the PPDR.

4. The inflight PPDR training should be conducted during the course of regularly scheduled student flights in the Cessna 172 aircraft. More than one airspace and traffic pattern should be used if possible.

TRAINING SEQUENCE FOR CONTACT PPDR

Training Day	Activity	Time(Hrs.)		
		Briefing	Flight[a]	Total
1	Explain: 1. General background and purpose of PPDR 2. Format of Contact PPDR 3. Use of Contact PPDR	2.0	0	2.0
2	Practice Contact PPDR data recording	0.5	1.0	3.5
3	Practice Contact PPDR data recording	0.5	1.0	5.0
4	Practice Contact PPDR data recording	0.5	1.0	6.5
5	Practice Contact PPDR data recording	0.5	1.0	8.0
6	Practice Contact PPDR data recording	0.5	1.0	9.5
7	1. Review practice recordings 2. Review procedure as required	1.0	0	10.5

[a]Flight times are estimates. Actual time will be the times required for regularly scheduled instructional events.

5. To the extent possible, it is desired that each checkpilot score each maneuver at least once each day during days 2-6. Thus, over the five-day flight training period, a minimum of five recordings for each maneuver for each checkpilot is desired. If a given training day includes more than the necessary number of PPDR training hours, it is requested that PPDR use occur within each hour, if possible. Multiple flights on one day should not be substituted for multiple (at least five) training days.

6. Materials - the checkpilots will have, in addition to all required E-RAU training materials:

   A. Contact PPDR Handbook

   B. Contact PPDR Folder

   C. Ten copies of Contact PPDR

7. General Training Instructions - Each checkpilot should include in his Contact PPDR folder a daily comment slip with:

   A. Information concerning PPDR training accomplished

   B. Any problem areas noted in data recording

   Additionally, each PPDR used during training flights should be dated and filed in chronological sequence. The training coordinator should be available before and after training flights to handle any questions or problems the checkpilots might have.

8. Training Schedule -

   The following daily training schedule should be followed as closely as possible:

Training Day 1

   A. Issue appropriate materials

   B. Explain and discuss (using Handbook):

      1. General background and purpose of PPDR

         - Standardization
         - Reliability
         - Description/Diagnosis
         - Validity
         - Objectivity
         - Recording/Evaluating
         - Use by other agencies
         - Safety-oriented
         - Sequential recording
         - Guiding principles of PPDR

C. Format of Contact PPDR

- Maneuver selection rationale
- Maneuvers/Segments/Measures
- Types of measures
- Tolerance band rationale

D. Use of Contact PPDR

- Marking the scales
- Multiple vs. single marks
- Omitted scales
- Dangerous performance
- CP assist
- Go-Arounds
- Weather factors
- Grade/Comments
- No instruction

Training Days 2-6

A. The previous training session should be reviewed each day.

B. Each checkpilot should record student performance using the Contact PPDR (1.0 hr. each day).

C. The training flight should be as similar as possible to a standard checkride without interference with regularly scheduled instructional activities. Maneuver sequencing can be varied to fit the instructional situation.

D. Emphasis should be placed upon accurate and timely scale entries for all PPDR measures.

E. The training coordinator should monitor each Contact PPDR folder daily to ensure that:

1. PPDR forms are correctly marked and filed

2. Daily comment slips are included

3. Problems noted on the comment slips are addressed

F. At the completion of Training Day 6, each Contact PPDR folder should be carefully inspected and turned in to the training coordinator.

Training Day 7

A. The training coordinator will review overall experience with the practice recordings with the checkpilot.

B. Corrections or changes in procedures will be discussed, as appropriate.

C. Final guidelines for PPDR administration will be given.

Post-Training Days

Checkpilots should use the PPDR in conjunction with regularly scheduled flying activities with frequency sufficient to ensure their retention of administrative skills until actual data collection begins.

CONTACT

Pilot Performance Description Record

1. Embry-Riddle Aeronautical University

STUDENT'S NAME	SSN
TRACK	AIRCRAFT
CHECK PILOT	DATE

2. WEATHER

	BEGINNING OF FLIGHT:	END OF FLIGHT:
X WIND	L / NONE / R; 15° 30° 45° 60°	L / NONE / R; 15° 30° 45° 60°
WIND VELOCITY (Knts)	5 10 15 20	5 10 15 20
GUSTS	NONE / LIGHT / MOD.	NONE / LIGHT / MOD.

3.

FLIGHT SAFETY

A B C D F

SMOOTHNESS

A B C D F

PLANNING & JUDGMENT

A B C D F

COLLISION AVOIDANCE

A B C D F

SHOR D TAKEOFF & DEPARTURE

GROUND RUN

FULL THROTTLE [NO] [YES]

RUNWAY CENTERLINE TRACK — LEFT — RIGHT

LIFTOFF

AIRSPEED — LOW — 55 (-5 / +5) — HIGH

ACCEPTABLE ROTATION [NO] [YES]

CLIMBOUT

AIRSPEED — LOW — -5 / +5 — HIGH

TRACK FROM EXTENDED RUNWAY — LEFT — RIGHT

BANK FOR EXIT — SHALLOW — -5 / +5 — STEEP

PROPER PATTERN EXIT [NO] [YES]

TRIM (FOR CLIMB) [NO] [YES]

LEVEL OFF

LOW — -50 / +50 — HIGH

TRIM (LEVEL FLIGHT) [NO] [YES]

SMOOTH CONTROL [NO] [YES]

CONTROL COORDINATION [NO] [YES]

[SLIP] [SKID]

GRADE [A] [B] [C] [D] [F]   TURBULENCE [NO] [YES]

COMMENTS:

APPROACH TO LANDING STALL RECOVERY

ENTRY

PROPER ENTRY SEQUENCE	NO	YES
AIRSPEED	LOW -5 55 +5 HIGH	
BANK	SHALLOW -5 +5 STEEP	

RECOVERY

STALL RECOGNIZED	NO	YES
FULL THROTTLE	NO	YES
PITCH DECREASED	NO	YES
BANK (WINGS LEVEL)	NO	YES
CARB HEAT OFF	NO	YES
ALTITUDE LOSS ACCEPTABLE	NO	YES

SMOOTH CONTROL	NO	YES

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

SLOW FLIGHT

ENTRY

PROPER ENTRY SEQUENCE [NO] [YES]

STRAIGHT & LEVEL

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100
HEADING	-10°	-5°	+5°	+10°

TURN

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100

RECOVERY

PROPER RECOVERY SEQUENCE [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE: [A|B|C|D|F] TURBULENCE: [NO] [YES]

COMMENTS:

180° TURN
INSTRUMENTS

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100
AIRSPEED	-10	-5	+5	+10
DEGREES TURNED	-10°	-5°	+5°	+10°

SMOOTH CONTROL [NO] [YES]

GRADE [A | B | C | D | F]   TURBULENCE [NO] [YES]

COMMENTS:

VOR

IDENTIFICATION

STATION TUNED PROPERLY	NO	YES
STATION IDENTIFIED	NO	YES
RADIAL IDENTIFIED	NO	YES

ALTITUDE CONTROL	-100	-50	+50	+100
HEADING CONTROL	-10°	-5°	+5°	+10°

TRACK TO STATION

TURN TO INBOUND HEADING	-10°	-5°	+5°	+10°
ALTITUDE CONTROL	-100	-50	+50	+100
AIRSPEED CONTROL	-10	-5	+5	+10

VOR TRACK ($\pm$ 1 dot)	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

TURNS ABOUT A POINT

ENTER DOWNWIND [NO] [YES]

1^{st} TURN

ALTITUDE -100 -50 0 +50 +100

AIRSPEED -10 -5 0 +5 +10

2^{nd} TURN

ALTITUDE -100 -50 +50 +100

AIRSPEED -10 -5 +5 +10

CONSTANT RADIUS TURN [NO] [YES]

PROPER EXIT HEADING -10° -5° +5° +10°

MAINTAIN AIRSPACE SCAN [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE [A] [B] [C] [D] [F]   TURBULENCE [NO] [YES]

COMMENTS:

TRAFFIC PATTERN

ENTRY

ANGLE (45°)	NO		YES	
ABEAM MIDPOINT	NO		YES	
ALTITUDE	-100	-50	+50	+100
RPM	-100	-50	+50	+100
DISTANCE OUT	TOO CLOSE			TOO FAR

DOWNWIND

ALTITUDE	-100	-50	+50	+100
COCKPIT CHECK	NO		YES	
REDUCE POWER	EARLY			LATE
AIRSPEED	-10	-5	+5	+10
FLAPS (10°)	NO		YES	
PROPER GROUND TRACK	NO		YES	
TURN STARTED (BASE)	EARLY			LATE

(TRAFFIC PATTERN)

BASE

AIRSPEED	-10	-5	+5	+10
PROPER GROUND TRACK	NO	YES		
PROPER FLAPS	NO	YES		
TURN STARTED (FINAL)	EARLY			LATE
TRIM	NO	YES		

FINAL

TRACK FROM EXTENDED RUNWAY	LEFT			RIGHT
AIRSPEED	-10	-5	+5	+10
DESCENT RATE	SLOW			FAST
APPROACH ANGLE	SHALLOW			STEEP
PROPER FLAPS	NO	YES		
TRIM	NO	YES		

GRADE A B C D F TURBULENCE NO YES

SOFT FIELD LANDING

TRANSITION (FLARE)

ALTITUDE — 20: -10, -5, +5, +10

PROPER FLARE RATE [NO] [YES]

PROPER FLARE ATTITUDE [NO] [YES]

TOUCHDOWN

TOUCHDOWN POINT — SHORT ... LONG

PROPER POWER [NO] [YES]

PROPER NOSE ATTITUDE [NO] [YES]

CONTACT — DROP ... BOUNCE

RUNWAY CENTERLINE TRACK — LEFT ... RIGHT

SMOOTH CONTROL [NO] [YES]

GRADE [A] [B] [C] [D] [F]   TURBULENCE [NO] [YES]

COMMENTS:

APPENDIX E

PILOT PERFORMANCE DESCRIPTION RECORD (PPDR) FOR THE INSTRUMENT CHECKRIDE

This appendix presents materials for the Instrument Checkride PPDR as they were adapted for the present experiment. Three items are included. First, the Handbook, which begins on page E-2, describes the PPDR and gives instructions for its use. Second, performance measure definitions and guidelines for recording data begin on page E-7. The PPDR forms used for recording performance begin on page E-11. The syllabus for training checkpilots to use the PPDR is the same as that for contact checkpilots. An outline of the syllabus appears in Appendix D, beginning on page D-11.

Instrument Checkride Handbook

<u>Pilot Performance Description Record (PPDR)</u>

I. Purpose

A. General - to provide a method of clearly describing and documenting student pilot performance

B. Specific - to provide objective performance data for evaluating instrument performance of E-RAU students in various training tracks.

II. Guiding Principles

A. to obtain a maximum of descriptive and specific judgmental information with a minimum of inflight marking

B. to be made compatible with existing FAA and E-RAU instrument checkride procedures

C. to provide a representative sample of student performance of those flying skills required to pass the Instrument Checkride.

III. PPDR Characteristics and General Utilization

A. Each flight maneuver in this PPDR has been analyzed and discussed with E-RAU personnel to determine its fundamental components. The analyses provided the basis for the development of descriptive and judgmental scales on which each performance component, such as direction, attitude, power, and flight path, could be quickly described by the checkpilot.

B. This PPDR includes a sample of the maneuvers described in the FAA flight test guide on which proficiency must be demonstrated to pass the checkride for the Instrument rating. This PPDR is intended to provide descriptive data for this maneuver sample, and as such, should be viewed as part of the checkride. Administration of this PPDR should not restrict or constrain the checkpilot's usual checkride prerogatives. In particular, inflight safety must not be jeopardized. Although the sequence of PPDR maneuvers should be standardized as described in E. below, it is recognized that these PPDR maneuvers will be interspersed throughout other checkride maneuvers. The performance description resulting from this PPDR is considered to be as complete as can be obtained efficiently by manual recording during a single flight period.

C. In any data collection effort, <u>reliability</u> (meaning consistency or repeatability of test result) and <u>validity</u> (meaning measurement of

that which is intended to be measured) are desirable goals. One necessary factor in achieving high levels of reliability and validity is standardization of the test sample, test conditions, and methods of data recording. The standardization of the flight test sample and the methods for administering and evaluating it is the aim of the PPDR.

D. This PPDR is separated into a number of instrument maneuvers to be recorded. Each maneuver is divided into segments that specify observations that are to be made as objectively as possible. During a flight check, student performance normally is recorded during or near the end of each maneuver segment, provided that performance is within the limits specified as "proper" on all scales in that segment. Whenever an error exceeding "proper limits" of a scale occurs, the checkpilot should record it immediately, regardless of how much of the segment is completed. If, later in the segment, the student exceeds his previous error on the same scale, the checkpilot makes a second mark farther out on the scale. Generally speaking, erratic performance is reflected by multiple marking; for example if the descent rate during an approach is uneven, both "slow" and "fast" may be marked.

E. There are three general levels of detail represented in the PPDR: (a) individual performance measures, (2) flight segments, and (3) maneuvers. Segments and measures are listed in the approximate sequence in which they occur during execution of the maneuver. This is intended to simplify and standardize inflight data recording.

Individual Performance Measures. The PPDR measuring scales show the detailed and descriptive criteria of student performance which underlie the evaluation made by the checkpilot. Examples of these scales are airspeed, altitude and ground track. These scales are recorded objectively by the checkpilot from instruments or clearly definable outside references. However, it is not always possible to find such outside references for certain crucial aspects of student performance. Consequently, a few scales are judgmental in nature, e.g., control smoothness. The checkpilot must use his judgment in evaluating and recording these items.

Flight Segments. The subdivision of each PPDR flight maneuver into its segments is indicated by single horizontal lines between segments. The segment breaks serve to remind the checkpilot of the time required for that particular group of measures. More importantly, they make it easier for the checkpilot to focus on a particular group of measures for the specific portion of flight performance being recorded. This reduces the difficulty in determining the flight performance sample to which each measure applies. Occasionally, a measure refers only to a specific part (beginning or end) of a segment, but these instances will be obvious to the checkpilot.

Segments and measures are sequenced from the top of the page to the bottom.

Maneuvers. There are several factors about the selected flight maneuvers that the PPDR seeks to control. One factor is the specification of performance measures and segments within maneuvers. The PPDR also requires that all students perform identical maneuvers, which ensures that the same behavioral patterns are sampled in all students. Because the sequence in which maneuvers are given during a flight check can affect the results, the sequence for the PPDR maneuvers will be standardized. The sequence settled upon should allow for maximum use of available time and resources. Due to the requirement for economy of time and effort in conducting the checkride, the performance sequence of certain maneuvers may be varied to expedite or to increase its efficiency or convenience. However, the standardized sequence should be followed as closely as possible. All maneuvers must be completed for each checkride.

F. PPDR reliability is dependent upon the degree of standardization achieved in administering the Instrument checkrides. It is essential that every checkpilot thoroughly understand each measure in this PPDR as described in this appendix. In addition to knowing the measure definitions, it is important that the checkpilot clearly understand that he has two roles, evaluator and recorder. In his normal role as evaluator, the checkpilot observes student performance throughout the entire checkride, and renders his assessment of the efficacy of issuing the Instrument rating on the basis of the proficiency that he observes. As a recorder, he is asked to provide accurate and descriptive information on the observed performance as it occurs and upon which his evaluation is ultimately based. The recording function is thus extremely critical to the PPDR data collection effort. To achieve the goal of accuracy and completeness of recording, the student's performance should be recorded as soon after it occurs as is practical, with due consideration for safety.

G. The checkpilot should maintain an impartial attitude toward the student, limiting conversation to explaining checkride requirements and conditions.

H. The student pilot should not be given detailed feedback relative to checkride performance prior to debriefing.

I. Measures included in this PPDR are of two types:

   1. Performance Scales with a desired range of values indicated by a triangular symbol at the scale midpoint, and errors (e.g., left/right) to either side of the triangle. For some measures, a desired value is specified at the top of the triangle. Other measures do not specify a desired value, indicating that the checkpilot must determine the correct desired value depending upon the aircraft, airspace, or prevailing conditions.

2. Categorical Measures (yes or no) requiring the checkpilot to determine whether or not the observed performance is within acceptable limits. This determination involves more complex judgment for some measures (e.g., compliance with ATC instructions) than others (e.g., report).

J. For the scale measures that include a specified deviation range (i.e., tolerance) around the midpoint, the tolerance band specified may or may not be identical to the standards given in the FAA flight test guide. These bands are not necessarily intended to denote FAA acceptable performance, but rather to generate accurate data to document observable performance differences.

K. This version of the PPDR is not intended for use in diagnosing student performance deficiencies. However, research has shown that use of the PPDR can lead to such diagnosis by providing instructors and training managers with a valid and reliable performance data base describing typical and atypical student performance. These data may then be used as an index of comparison (norm) for any given student's observed performance, and therefore, provide effective performance feedback to the student.

IV. PPDR Data Recording

A. The cover page of the PPDR is divided into three parts. Part One contains descriptive information about the student, checkpilot, aircraft, etc. and should be completed in its entirety prior to the checkride. Part Two contains weather data. The appropriate conditions (IFR or VFR) as well as existing wind speed and gust should be recorded both before and after the checkride. Part Three includes four subjective measures of pilot skill. Each measure should be slash marked with the E-RAU grade which, in the judgment of the checkpilot, best describes the overall checkride performance of the student on that factor.

B. Each scale should be marked with at least one slash mark of approximately 1/4 inch in length. The mark should pass clearly and evenly through the scale such that there is no doubt about which scale or which portion of the scale the checkpilot intended to mark. Categorical measures should include a slash mark in the appropriate box.

C. For those segments encompassing an extended period of time (e.g., bank in a turn) multiple marks may be necessary. This gives a record of deviations as they are observed without forcing the checkpilot to rely upon his memory of an extended performance segment. Errors observed in both directions (e.g., low and high) should be appropriately recorded. Short term segments (e.g., VOR station passage) should include only one mark for each measure. Requirement for multiple marking should be apparent to checkpilots.

D. If dangerous performance occurs, the checkpilot should write a letter "D" in the left margin and draw a line to the scale(s) reflecting the dangerous performance. If a maneuver is aborted because of student-induced dangerous performance, an additional notation should be made in the margin and all remaining measures on that maneuver marked in error.

E. If the checkpilot finds it necessary to assist the student with a maneuver, "CP Assist" should be noted in the margin for the affected portion of the maneuver or segment.

F. The checkpilot should mark the appropriate E-RAU grade for each PPDR maneuver, and write any additional comments that he deems pertinent to the recorded performance data in the spaces provided at the bottom of each maneuver form. He may also write to the side of, or directly above measures or segments, time and space permitting.

G. Data recording for each PPDR maneuver should be complete. If certain measures are not marked, the reason for the incomplete form should be noted.

Instrument PPDR

Performance Measure Definitions and Recording Guidelines

The PPDR provides a record of what actually occurs during the checkride. The maneuvers included in this PPDR are intended to be performed under favorable checkride conditions (i.e., no more than light to moderate wind and turbulence effects). As such, the PPDR maneuvers should not be deliberately assigned under extremely windy or turbulent conditions. However, if it is necessary to administer the PPDR in such conditions, an accurate recording of the characteristics of those conditions before and after the checkride will enable them to be considered in the overall analysis of performance. The checkpilot must not allow extraneous factors to influence his marking of the actual performance scales.

Measures are of two general types. One is a scale with a triangle (▲) provided at midpoint. The triangle should be marked if performance is within non-error limits (i.e., proper). Otherwise, deviations from these limits should be marked in the appropriate error direction (e.g., low or high). Recording should not attempt to reflect the exact number of units of deviation from the midpoint (e.g., both 6 Kts and 9 Kts should be marked midway between 5 and 10 Kts.)

The other measure is categorical, requiring the checkpilot to mark either "yes" or "no" depending on whether the observed performance relative to the measure was, in his judgment, acceptable. Measure definitions should be followed in this determination.

A Grade/Comment section is included at the end of each maneuver. Here the checkpilot should enter the E-RAU grade (A, B, C, D, F) that best describes the overall quality of the maneuver performance recorded in the PPDR, and write any comments that he feels are pertinent to the performance. He may also write to the side of, or directly above measures or segments, time and space permitting.

Performance Measures

Aircraft Control - Mark "Yes" is confident and accurate control of the aircraft takes priority at MAP; if preoccupation with other tasks or hesitation occurs, mark "No".

Aircraft Performance Data - Mark "Yes" if flight manual information can be accurately applied to the aircraft's performance characteristics and capabilities; otherwise, mark "No".

Airspeed - If observed airspeed is within ± 5 knots of the desired airspeed, proper should be marked; otherwise the direction and magnitude of error should be marked.

Altitude - If observed altitude is within ±50 feet of desired altitude, mark proper; otherwise, the direction and magnitude or error should be marked.

Assigned Airspeeds Attained - Mark "Yes" if all assigned airspeeds are attained within +2 knots; otherwise, mark "No".

Avionics - Mark "Yes" if student can demonstrate the skillful use of radio communications procedures for report, ATC clearances, or other functions; otherwise mark "No".

Bank - When turning, if the desired bank angle is maintained within ±5°, proper should be marked; otherwise, the direction and magnitude of error should be marked.

CDI Needle Centered - Mark "Yes" if the CDI needle remains within the doughnut during orientation otherwise, mark "No".

Clearance - Mark "Yes" if student can correctly obtain necessary ATC clearance prior to takeoff; otherwise, mark "No".

Compliance with All ATC Instructions - Mark "Yes" if student understands and correctly responds to all ATC instructions; otherwise mark "No".

Compliance with Part 91 and AIM Procedures - Mark "Yes" or "No" as appropriate.

Control Coordination - A measure of general control skill, mark "Yes" if student maintains coordinated flight (± 1 ball) during turn; otherwise, mark "No".

Correct and Timely Control Movements - If control inputs are both correct and timely in recovering from the unusual attitude, mark "Yes"; if hesitation or improper inputs are observed, mark "No".

Course Tracking (±2°) - Mark "Yes" if track is maintained within ±2° of desired course; otherwise, mark "No".

Degrees Turned - Mark proper if the observed number of degrees turned is within ±5° of the desired number of degrees turned; otherwise, mark the direction and magnitude of error.

ETA - Mark "Yes" if student's ETA is within ±5 minutes of actual arrival; otherwise, mark "No".

Flight Log - Mark "Yes" if flight log contains all information (e.g., enroute courses, fuel requirements, estimated ground speeds, ETE's) pertinent to selected route; otherwise, mark "No".

Glide Slope (±1 dot) - Mark "Yes" if glide slope is maintained within ± 1 dot of doughnut; otherwise mark "No".

Initial Altitude Recovered - Mark "Yes" or "No" as appropriate.

Initial Heading Recovered - Mark "Yes" or "No" as appropriate.

Instruments and Equipment - Mark "Yes" if student can thoroughly and accurately perform operation checks of engine instruments, flight instruments, and avionics; otherwise, mark "No".

MDA - If observed altitude on final approach remains within, but not below 100 feet of the published MDA, mark "Yes"; otherwise, mark "No".

Pitch/Power Coordination - Mark "Yes" if aircraft pitch is properly controlled when applying power for airspeed change; otherwise, mark "No".

Procedures - Mark "Yes" if all required procedures are performed in an accurate and timely manner; otherwise, mark "No".

Proper Entry - If all necessary procedures are performed in the correct sequence during entry to a segment, mark "Yes"; if any procedure is omitted or out of sequence, mark "No".

Proper Judgment - Mark "Yes" if student exhibits proper judgment in view of the situation or emergency; otherwise, mark "No".

Proper Lead/Lag - Mark "Yes" if rollout on mag compass turn reflects the correct lead or lag ($\pm 5°$) for the assigned heading; otherwise, mark "No.

Proper Power Change - Mark "Yes" if the power change, within acceptable limits, is that necessary to effect the desired airspeed change; otherwise, mark "No".

Proper Sequence - Mark "Yes" if recovery sequence is correct; otherwise, mark "No".

Proper Setup - If all assigned flight variables are within their desired range or condition upon initiating the maneuver, mark "Yes"; otherwise mark "No".

Proper Timing - Mark "Yes" if timing for all legs of a holding pattern is within desired limits; otherwise mark "No".

Proper Turn - Mark "Yes" if the turn is initiated and terminated at the proper time, and executed at the proper rate; otherwise, mark "No".

Radio Calls - Mark "Yes" if student demonstrates all necessary radio communications prior to takeoff; otherwise, mark "No".

Recognition of Attitude - If student recognized aircraft attitude upon taking the controls, mark "Yes"; if control movements indicate that the aircraft attitude has not been recognized, mark "No".

Report - Mark "Yes" if student gives accurate and timely report of position and intention to ATC; if student forgets to report or gives incorrect information, mark "No".

Reset DG - Mark "Yes" if directional gyro is reset accurately prior to tuning a station; otherwise mark "No".

Rolled Out on Course - Mark "Yes" if turn is terminated within 5° of the desired course; otherwise mark "No".

Route Selection - Mark "Yes" if cross-country route selected is acceptable; otherwise, mark "No".

Smooth Control - If control movements are judged smooth and coordinated for all segments of a maneuver, mark "Yes". If any segment contains control movements that are erratic, of excessively large magnitude or frequency, or otherwise unacceptable, mark "No".

Station Tuned, Identified - Mark "Yes" or "No" as appropriate.

Timely and Accurate Response to Emergency - Mark "Yes" or "No" as appropriate.

Timely Compliance with All Procedures - Mark "Yes" if all missed approach procedures are followed without hesitation; otherwise, mark "No".

Track (ILS, ADF) - Mark "Yes" if heading remains within ±2° of course to the station during the entire segment; otherwise mark "No".

Track (VOR) - Mark "Yes" if the needle remains within the doughnut during the entire segment; otherwise, mark "No".

Transponder - Mark "Yes" if student can correctly tune the assigned transponder frequency prior to takeoff, otherwise, Mark "No".

Vertical Speed - Mark "Yes" if observed vertical speed is within ±50 fpm of desired vertical speed in a climb or descent; otherwise, mark "No".

Weather Information - Mark "Yes" if all weather information pertinent to the selected route is obtained and analyzed; otherwise, mark "No".

Instrument Checkride

Pilot Performance Description Record

Embry-Riddle Aeronautical University

1.

STUDENT'S NAME	SSN
TRACK	AIRCRAFT
CHECK PILOT	DATE

2. WEATHER

BEGINNING OF FLIGHT:	END OF FLIGHT:
IFR VFR	IFR VFR
WIND VELOCITY (Knts) 5 10 15 20	WIND VELOCITY (Knts) 5 10 15 20
GUSTS NONE LIGHT MOD.	GUSTS NONE LIGHT MOD.

3.

FLIGHT SAFETY

A B C D F

SMOOTHNESS

A B C D F

PLANNING & JUDGMENT

A B C D F

COMMUNICATIONS PROCEDURES

A B C D F

STRAIGHT AND LEVEL (60 secs)

SETUP

PROPER SETUP   NO   YES

EXECUTION

HEADING	-10°	-5°	+5°	+10°
AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100

GRADE   A B C D F   TURBULENCE   NO   YES

COMMENTS:

SETUP

PROPER SETUP [NO] [YES]

ROLLIN

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100

MAINTAIN

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100

ROLLOUT

ALTITUDE	-100	-50	+50	+100
DEGREES TURNED	-10°	-5°	+5°	+10°

PROPER LEAD/LAG [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE [A] [B] [C] [D] [F] TURBULENCE [NO] [YES]

COMMENTS:

SLOW FLIGHT

ENTRY

PROPER ENTRY SEQUENCE [NO] [YES]

STRAIGHT AND LEVEL

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100
HEADING	-10°	-5°	+5°	+10°

TURN

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100

RECOVERY

PROPER SEQUENCE [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE [A] [B] [C] [D] [F] TURBULENCE [NO] [YES]

COMMENTS:

VOR

ORIENTATION

RESET DG	NO	YES		
STATION TUNED, IDENTIFIED	NO	YES		
CDI NEEDLE CENTERED	NO	YES		
ASSIGNED ALTITUDE	-100	-50	+50	+100
ASSIGNED HEADING	-10°	-5°	+5°	+10°

APPROACH

ROLLED OUT ON COURSE(±5°)	NO	YES		
TRACK	NO	YES		
MDA (+100ft)	NO	YES		
AIRSPEED	-10	-5	+5	+10

MISSED APPROACH

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
AIRCRAFT CONTROL	NO	YES

COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

ADF APPROACH

RESET DG	NO	YES
STATION TUNED, IDENTIFIED	NO	YES
COURSE INTERCEPTED (±10°)	NO	YES
ROLLED OUT ON COURSE(±5°)	NO	YES
PROPER TRACK	NO	YES
WIND CORRECTION	NO	YES
MDA	NO	YES

AIRSPEED

MISSED APPROACH

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
AIRCRAFT CONTROL	NO	YES

COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

ILS APPROACH

TRACKING TO OM

STATION TUNED, IDENTIFIED	NO	YES
COURSE INTERCEPTED	NO	YES
ROLLED OUT ON COURSE (±5°)	NO	YES
PROPER TRACK	NO	YES

ALTITUDE -100 -50 +50 +100

GLIDESLOPE INTERCEPTED (± 1 dot)	NO	YES

APPROACH

ALTITUDE -100 -50 +50 +100

REPORT	NO	YES

AIRSPEED -10 -5 +5 +10

COURSE TRACKING (±2°)	NO	YES
GLIDE SLOPE (± 1 Dot)	NO	YES
PROPER TIME	NO	YES
ALTITUDE=OM (+100FT)	NO	YES

ILS

MISSED APPROACH (if applicable)

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES
AIRCRAFT CONTROL	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

HOLDING

	VOR	ADF	OTHER
PROPER ENTRY	NO	YES	
TRACK	NO	YES	
PROPER TIMING	NO	YES	
PROPER TURN RATE	NO	YES	
ALTITUDE	-100	-50 +50	+100
AIRSPEED	-10	-5 +5	+10
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES	

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

PROCEDURE TURN | VOR | ADF | OTHER

PROPER TURN	NO	YES	
TRACK	NO	YES	
PROPER TIMING	NO	YES	
ALTITUDE	-100	-50 +50	+100
AIRSPEED	-10	-5 +5	+10
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES	

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

CROSS COUNTRY (ORAL)

ROUTE SELECTION	NO	YES
WEATHER INFORMATION	NO	YES
FLIGHT LOG	NO	YES
AIRCRAFT PERFORMANCE DATA	NO	YES
INSTRUMENTS & EQUIPMENT	NO	YES
AVIONICS	NO	YES
ENROUTE PROCEDURES	NO	YES
TERMINAL PROCEDURES	NO	YES
PROPER JUDGMENT	NO	YES

GRADE A B C D F

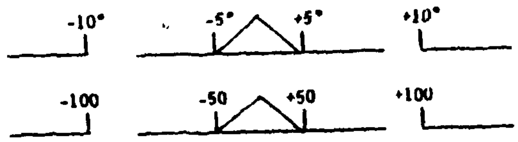
COMMENTS:

RADAR VECTOR　　[NO]　[YES]　[OTHER]

COMPLIANCE WITH ALL ATC INSTRUCTIONS AND IFR PROCEDURES　　[NO]　[YES]

HEADING

ALTITUDE



GRADE [A|B|C|D|F]　　TURBULENCE [NO]　[YES]

COMMENTS:

EMERGENCY PROCEDURE -
LOSS OF RADIO COMMUNICATIONS

TIMELY AND ACCURATE RESPONSE TO EMERGENCY　　[NO]　[YES]

COMPLIANCE WITH PART 91 AND AIM PROCEDURES　　[NO]　[YES]

MAINTAIN ALTITUDE ($\pm$100ft)　　[NO]　[YES]

MAINTAIN HEADING ($\pm$10°) OR TURN RATE ($\pm$1°sec)　　[NO]　[YES]

PROPER JUDGMENT　　[NO]　[YES]

GRADE [A|B|C|D|F]　　TURBULENCE [NO]　[YES]

COMMENTS:

APPENDIX F

DAILY PROGRESS RECORD (DPR) FOR INSTRUMENT TRAINING

This appendix presents materials for the DPR that was used to record performance during instrument training. Three items are included. First, the User's Guide, which begins on page F-2, describes the DPR and gives instructions for its use. Second, the performance measures to be included, and specific instructions for recording them, begin on page F-5. Third, the DPR forms used for recording performance begin on page F-7.

User's Guide

Daily Progress Record (DPR)

Instrument Maneuvers

I. Purpose

A. The purpose of the DPR is to record and document the attainment of various specified performance criteria for E-RAU instrument maneuvers and procedures.

B. This documentation will result in objective performance data to be used in the assessment of Instrument proficiency of those E-RAU students receiving three different amounts of Contact training.

II. Principles

The DPR is intended

A. to provide a descriptive profile of performance occurring across training days without requiring excessive "head-in-cockpit" recording time by instructors;

B. to be made compatible with the Instrument PPDR used for recording checkride performance;

C. to provide a means of depicting the rate of change in Instrument flying skill over training time.

III. Characteristics

A. The maneuvers and procedures included in this DPR are representative of those described in the FAA Instrument Test Guide on which E-RAU students must demonstrate proficiency to obtain the instrument rating. Each maneuver has been analyzed with respect to what must be accomplished to result in its successful performance. These performance requirements are related to aircraft state and may be observed and recorded in a relatively objective manner.

B. Use of this DPR should not restrict or otherwise interfere with instruction. The DPR is a research tool intended for performance measurement purposes only. Instructors should employ their usual instructional techniques.

C. Inflight safety must, of course, take precedence over all other training activities including both instruction and data recording.

D. The DPR maneuvers will likely be interspersed throughout other instrument maneuvers. DPR data recording should, therefore, be a part of, rather than an addition to, each daily training session. IV.

IV. Format

A. The first page of the DPR booklet contains descriptive information concerning the student and instructor. It should be completed prior to beginning DPR data recording. Each student will have a separate DPR booklet which will be used by the instructor to record that students' data throughout instrument training.

B. The DPR consists of maneuvers (e.g., Turns) which are subdivided into a number of segments (e.g., Rollin) and measures (e.g., Altitude). Each measure includes either a qualitative definition or quantitative tolerance level. Qualitative definitions are given in the appendix of this guide. Quantitative tolerance levels are specified beside the appropriate measures in the DPR. An example of a measure for which a qualitative definition is required is "Proper Setup." Quantitative tolerance levels are specified for such measures as "Altitude" (± 50 ft) and "Airspeed" (± 5 kts). Measures such as Heading and Altitude commonly are used more than once for most DPR maneuvers.

V. Data Recording

A. In marking the DPR, the instructor must ascertain, solely on the basis of the specified definition or tolerance level for each measure, whether the observed performance satisfies the definition or tolerence level for that measure. If the measure is determined to be within acceptable limits, a check (✓) is marked in the box adjacent to the measure. If not within limits, an X should be marked in the box. No allowances should be made for extraneous factors (e.g., amount of training) in making this determination. End-of-phase standards should, without exception, be used for assessing all maneuvers and measures.

B. Data should be recorded from the top to bottom in each column although columns are broken according to segment. The top box in each column should include a different training date (i.e., data recording for a given DPR maneuver should occur no more than once for a given training day). Further, data for any DPR maneuver should be recorded for the first execution of the maneuver on any given day. This provides some control for practice effects and hence, increases the validity of DPR data.

C. Recording for DPR maneuvers should be complete (i.e., if the first measure of any column contains a mark, all measures of that column must contain a mark). If, for some reason, it is not possible to record data for the entire maneuver, reasons for the incomplete recording should be noted on the DPR form.

AD-A099 414 EMBRY-RIDDLE AERONAUTICAL UNIV DAYTONA BEACH FL F/G 5/9
THE EFFECTS OF PILOT EXPERIENCE ON ACQUIRING INSTRUMENT FLIGHT --ETC(U)
MAR 81 J M CHILDS, W W PROPHET, W D SPEARS DOT-FA79NA-6040

UNCLASSIFIED FAA-CT-81-38 NL

2 2

END
DATE
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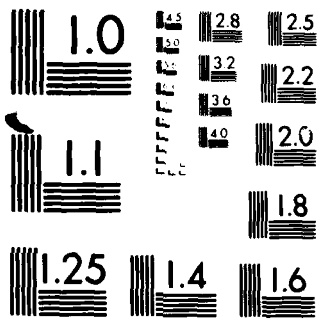

D. With due consideration for inflight safety, all measures should be recorded as they occur during the execution of the DPR maneuver. If it is not possible to mark the DPR maneuver, as it is being performed, this should be done as soon after the observed performance as possible. This decreases reliance on memory, and increases data validity.

E. A sample of a correctly recorded DPR maneuver is shown below.

STRAIGHT & LEVEL (60 secs)

Date	1/3	1/4	1/7	1/8	1/11	1/12	1/13	1/14		
Setup	(↓)									
Proper Setup	X	X	X	X	✓	X	X	✓		
Execution	(↓)									
HDG ($\pm$5°)	✓	✓	X	X	✓	X	✓	✓		
A/S ($\pm$5kts)	X	X	X	✓	✓	X	✓	X		
ALT ($\pm$50ft)	X	✓	X	✓	✓	✓	✓	✓		

DPR Performance Measure Definitions and Recording Guidelines

Aircraft Control - Insert checkmark if confident and accurate control of the aircraft takes priority during a missed approach; if preoccupation with other tasks or hesitation occurs, mark X.

Aircraft Performance Data - Insert checkmark if flight manual information can be accurately applied to the aircraft's performance characteristics and capabilities; otherwise, mark X.

All A/S Attained - Insert checkmark if all assigned airspeeds are attained with ±2 knots; otherwise, mark X.

Centered Needle - Insert checkmark if the CDI needle remains within the dough-nut during orientation; otherwise, mark X.

Clearance - Insert checkmark if student can correctly obtain necessary ATC clearance prior to takeoff; otherwise, mark X.

Compliance with All ATC Instructions - Insert checkmark if student understands and correctly responds to all ATC instructions; otherwise mark X.

Compliance with All Procedures - Insert checkmark if student complies (timely and accurately) with all missed approach procedures; otherwise, mark X.

Compliance with Part 91 and AIM Procedures - Insert checkmark or X as appropriate.

Coordination - A measure of general control skill, insert checkmark if student maintains coordinated flight (± ball) during turn. Otherwise, mark X.

Correct Number of Degrees Turned (±5°) - Insert checkmark if actual number of degrees turned is within 5° of desired number of degrees for the amount of time in the turn; otherwise, mark X.

Correct and Timely Control Movements - If control inputs are both correct and timely in recovering from the unusual attitude, insert checkmark; if hesitation or improper inputs are observed, mark X.

Course Tracking (±2°) - Insert checkmark if track is maintained within ±2° of desired course; otherwise, mark X.

Flight Log - Insert checkmark if flight log contains all information (e.g., enroute courses, fuel requirements, estimated ground speeds, ETE's) pertinent to selected route; otherwise, mark X.

Glide Slope ($\pm$1 dot) - Insert checkmark if glide slope is maintained within $\pm$1 dot of doughnut; otherwise mark X.

Instruments and Equipment - Insert checkmark if student can thoroughly and accurately perform operation checks of engine instruments, flight instruments, and avionics; otherwise, mark X.

Procedures - Insert checkmark if all required procedures are performed in an accurate and timely manner; otherwise, mark X.

Position Established - Insert checkmark if student correctly establishes position relative to station or desired course; otherwise, mark X.

Proper Entry - If all necessary procedures are performed in the correct sequence during entry to a segment, insert checkmark; if any procedure is omitted or out of sequence, mark X.

Proper Judgment - Insert checkmark if student exhibits proper judgment in view of the situation or emergency; otherwise, mark X.

Proper Power Change - Insert checkmark if the power change, within acceptable limits, is that necessary to effect the desired airspeed change; otherwise, mark X.

Proper Setup - If all assigned flight variables are within their desired range or condition upon initiating the maneuver, insert checkmark; otherwise mark X.

Proper Timing - Insert checkmark if timing for all legs of a procedure turn, holding pattern, or approach is within desired limits; otherwise mark X.

Proper Track (ILS, ADF) - Insert checkmark if heading remains within $\pm$2° of course to the station during the entire segment; otherwise mark X.

Proper Track (VOR) - Insert checkmark if the needle remains within the doughnut during the entire segment; otherwise, mark X.

Proper Turn - Insert checkmark if the turn is initiated and terminated at the proper time, and executed at the proper rate; otherwise, mark X.

Radio Calls - Insert checkmark if student demonstrates all necessary radio communications prior to takeoff; otherwise, mark X.

Recognition of Attitude - If student recognizes aircraft attitude upon taking the controls, insert checkmark; if control movements indicate that the aircraft attitude has not been recognized, mark X.

Report - Insert checkmark if student gives accurate and timely report of position and intention to ATC; if student forgets to report or gives incorrect information, mark X.

Reset DG - Insert checkmark if directional gyro is reset accurately prior to tuning a station; otherwise mark X.

INSTRUMENT

DAILY PROGRESS RECORD (DPR)

EMBRY - RIDDLE AERONAUTICAL UNIVERSITY

STUDENT

SSN

TRACK

INSTRUCTOR

STRAIGHT AND LEVEL (60 secs)

Date										

ALT (±50 ft)										
A/S (±5 kts)										
HDG (±5°)										

Smooth Control										

Airspeed Change

Date										

SETUP

Proper Setup										

POWER CHANGE

Proper Power Change										
ALT ($\pm$50ft)										
HDG($\pm$5°)										

All A/S Attained ($\pm$5 Kts)										
Smooth Control										

180°
TURN

Date										
Proper Setup										
ROLLIN										
Proper Bank($\pm$5°)										
ALT ($\pm$50ft)										
MAINTAIN										
Proper Bank($\pm$5°)										
ALT ($\pm$50ft)										
Coordination										
ROLLOUT										
ALT ($\pm$50ft)										
180°($\pm$5°) turned										
Smooth Control										

CLIMB/DESCENT

1 ☐ Constant A/S   2 ☐ Constant Rate

Date										
Proper Setup										
INITIATE										
Proper Power Change										
A/S(±5kts)										
HDG(±5°)										
MAINTAIN										
VS(±50fpm)										
A/S(±5kts)										
HDG(±5°)										
LEVELOFF										
ALT(±50ft)										
A/S(±5kts)										
HDG(±5°)										
Smooth Control										

VOR

Date										

ORIENTATION

Reset DG										
Station Tuned & Identified										
Centered needle										
ALT(±50ft)										
HDG(±5°)										

APPROACH

Roll Out on Course (±5°)										
TRACK (±1 dot)										
MDA(+100ft)										
A/S(±5kts)										

MISSED APPROACH

Report										
Compliance with all procedures										
Aircraft control										

Compliance with ATC procedures										

ADF APPROACH

Date										

APPROACH

Reset DG										
Station Tuned & Identified										
Course Intercepted ($\pm 10°$)										
Roll Out on Course($\pm 5°$)										
Proper Track										
Wind Correction										
MDA (+50ft)										
A/S ($\pm$5kts)										

MISSED APPROACH

Compliance with all procedures										
Report										
Aircraft Control										

Compliance with ATC instructions										

ILS APPROACH

Date										

TRACKING TO OM

Station Tuned & Identified										
Course Intercepted (±10°)										
Roll Out on Course (±5°)										
Proper Track										
ALT (±50ft)										
Glideslope Intercepted (±1 dot)										

APPROACH

ALT(±50ft)										
A/S(±5kts)										
Report										
Course Tracking (±1 dot)										
Glideslope (±1 dot)										
ALT-DH (+100ft)										

ILS APPROACH

MISSED APPROACH

Compliance with all procedures										
Report										
Aircraft Control										
Compliance with ATC instructions										

HOLDING

1 VOR   2 ADF   3 OTHER

Date										

Proper Entry										
Proper Track										
Proper Timing										
Proper Turn Rate										
ALT ($\pm$50ft)										
A/S ($\pm$5kts)										
Compliance with ATC instructions										

PROCEDURE TURN   1 VOR   2 ADF   3 OTHER

Date										

Proper Track										
Proper Timing										
Proper Turn										
ALT ($\pm$50ft)										
A/S($\pm$5kts)										
Compliance with ATC instructions										

CROSS COUNTRY

Date										

Route Selection										
Weather Information										
Flight Log										
Aircraft Performance Data										
Instruments & Equipment										
Enroute Procedures										
Terminal Procedures										
Proper Judgment										

EMERGENCY PROCEDURES

Date										

LOSS OF RADIO COMMUNICATION

Compliance with all ATC instructions										
Compliance with Part 91 and AIM Procedures										
ALT($\pm$100ft)										
HDG($\pm$10°) or Turn Rate ($\pm$1°/sec)										
Proper Judgment										

EQUIPMENT/INSTRUMENT MALFUNCTION

Compliance with all ATC instructions										
ALT($\pm$100ft)										
HDG($\pm$10°) or Turn Rate ($\pm$1°/sec)										
Proper Judgment										

UNUSUAL ATTITUDE RECOVERIES

Date										

RECOGNITION

Recognition of Attitude										

RECOVERY

Correct Control Movements										
Initial ALT recovered ($\pm$100ft)										
HDG control										
Smooth Control										

APPENDIX G

CONTROLLED TRAINING SYLLABI

CONTROLLED TRAINING SYLLABI

TRACK A

ERAU COURSE	PHASE	LESSONS	UNITS	PHASE TITLE
FA 102-7	I	001-009	001-019	Presolo
	II	010-014	020-042	Basic Flying
FA 103-7	III	015-019	043-055	Presolo Cross-Country
	IV	020-021	056-066	Private Pilot
	V	022	067-073	Night Operations
FA 203-7	VI	023-027	074-087	BAI/Radio Navigation
	VII	028-036	088-118	IFR Operations
FA 204-7	VIII	037-038	119-128	Advanced Solo Cross-Country
	IX	039-041	129-148	Commercial Maneuvers
FA 305-7	X	042-045	149-177	Complex Transition (Comm)
	XI	046-047	178-189	Complex Transition (Inst)

TRACK A TRAINING SYLLABUS

E-RAU Course	Phase	Dual	DXC[a]	Solo	SXC[b]	S.I.[c]	Oral	GAT[d]	Night
FA 102-7	Presolo	13.0		1.2			5.3		
	Basic Flying	7.2		10.8		1.0	6.0	1.0	1.2
FA 103-7	Presolo Cross-Country	5.2	5.2	11.2	10.0	.6	6.7	1.0	
	Private Pilot	3.6		6.0		.5	4.6		
	Night Operations	1.0		5.0			1.4		6.0
FA 203-7	BAI/Radio Navigation	6.0				6.0	7.3	5.0	
	IFR Operations	19.0	3.5			19.0	14.0	10.0	
FA 204-7	Advanced Solo Cross-Country	4.0	4.0	30.0	30.0	1.0	4.5		2.0
	Commercial Maneuvers	7.0		15.0			4.2		
FA 305-7	Complex Transition (C)	7.0		20.8			6.9		
	Complex Transition (I)	5.0				5.0	4.7	3.0	
	Totals:	78.0	12.7	100.0	40.0	33.1	65.6	20.0	9.2

[a] Dual Cross-Country

[b] Solo Cross-Country

[c] Simulated Instruments

[d] General Aviation Trainer

CONTROLLED TRAINING SYLLABI

TRACK B

ERAU COURSE	PHASE	LESSONS	UNITS	PHASE TITLE
FA 102-8	I	001-009	001-019	Presolo
	II	010-014	020-042	Basic Flying
FA 103-8	III	015-019	043-055	Presolo Cross-Country
	IV	020-021	056-066	Private Pilot
	V	022	067-073	Night Operations
FA 203-8	VIII	037-038	119-128	Advanced Solo Cross-Country
	VI	023-027	074-087	BAI/Radio Navigation
	VII	028-036	088-118	IFR Operations
FA 204-8	IX	039-041	129-148	Commercial Maneuvers
FA 305-8	X	042-045	149-177	Complex Transition (Comm)
	XI	046-047	178-189	Complex Transition (Inst)

TRACK B TRAINING SYLLABUS

E-RAU Course	Phase	Dual	DXC[a]	Solo	SXC[b]	S.I.[c]	Oral	GAT[d]	Night
FA 102-8	Presolo	13.0		1.2			5.3		
	Basic Flying	7.2		10.8		1.0	6.0	1.0	1.2
FA 103-8	Presolo Cross-Country	5.2	5.2	11.2	10.0	.6	6.7	1.0	
	Private Pilot	3.6		6.0		.5	4.6		
	Night Operations	1.0		5.0			1.4		6.0
FA 203-8	Advanced Solo Cross-Country	4.0	4.0	30.0	30.0	1.0	4.5		2.0
	BAI/Radio Navigation	6.0				6.0	7.3	5.0	
	IFR Operations	19.0	3.5			19.0	14.0	10.0	
FA 204-8	Commercial Maneuvers	7.0		15.0			4.2		
FA 305-8	Complex Transition (C)	7.0		20.8			6.9		
	Complex Transition (I)	5.0				5.0	4.7	3.0	
	Totals:	78.0	12.7	100.0	40.0	33.1	65.6	20.0	9.2

[a]Dual Cross-Country

[b]Solo Cross-Country

[c]Simulated Instruments

[d]General Aviation Trainer

CONTROLLED TRAINING SYLLABI

TRACK C

ERAU COURSE	PHASE	LESSONS	UNITS	PHASE TITLE
FA 102-9	I	001-009	001-019	Presolo
	II	010-014	020-042	Basic Flying
FA 103-9	III	015-019	043-055	Presolo Cross-Country
	IV	020-021	056-066	Private Pilot
	V	022	067-073	Night Operations
FA 203-9	VIII	037-038	119-128	Advanced Solo Cross-Country
	*IX-ZULU	039-041	129-155	Commercial Maneuvers
FA 204-9	VI	023-027	074-087	BAI/Radio Navigation
	VII	028-036	088-118	IFR Operations
FA 305-9	*X-ZULU	042-045	156-185	Complex Transition (Comm)

*All Phases in each track are the same except IX-ZULU and X-ZULU.

TRACK C TRAINING SYLLABUS

E-RAU Course	Phase	Dual	DXC[a]	Solo	SXC[b]	S.I.[c]	Oral	GAT[d]	Night
FA 102-9	Presolo	13.0		1.2			5.3		
	Basic Flying	7.2		10.8		1.0	6.0	1.0	1.2
FA 103-9	Presolo Cross-Country	5.2	5.2	11.2	10.0	.6	6.7	1.0	
	Private Pilot	3.6		6.0		.5	4.6		
	Night Operations	1.0		5.0			1.4		6.0
FA 203-9	Advanced Solo Cross-Country	4.0	4.0	30.0	30.0	1.0	4.5		2.0
	Commercial Maneuvers	12.0		18.0			4.2		
FA 204-9	BAI/Radio Navigation	6.0				6.0	7.3	5.0	
	IFR Operations	19.0	3.5			19.0	14.0	10.0	
FA 305-9	Complex Transition (C)	7.0		17.8		.6	6.9	3.0	
	Totals:	78.0	12.7	100.0	40.0	28.7	60.9	20.0	9.2

[a] Dual Cross-Country

[b] Solo Cross-Country

[c] Simulated Instruments

[d] General Aviation Trainer

APPENDIX H

CHECKPILOT AND INSTRUCTOR BACKGROUND DATA

This appendix presents background data for the checkpilots and instructors used in the study, including age, sex, education, and flight experience. The last of these, flight experience, is shown as total flight time, total instrument time, total dual flight time while instructing, and total instrument dual flight time while instructing.

E-RAU CHECKPILOT BACKGROUND DATA

Check-pilot No.	Age	Sex	Education	Total Time	Instrument Time	Dual Given	Instrument Dual Given
1	47	M	BA	7758	485	4500	3260
2	28	M	Assoc	5980	495	4900	2670
3	37	M	BS	3500	225	2800	1000
4	36	M	BS	3200	150	2660	1060
5	40	M	-	1980	168	1660	1000
6	42	M	PhD	5300	356	3570	1420
7	58	M	BS	6795	1150	930	380
8	48	M	BS	7300	1033	2650	820

E-RAU INSTRUCTOR BACKGROUND DATA

Instructor No.	Age	Sex	Education	Total Time	Instrument Time	Dual Given	Instrument Dual Given
1	21	F	BS	600	50	370	30
2	23	M	BS	912	40	660	153
3	21	M	Aero Sc	1300	80	800	350
4	26	M	-	1550	73	1110	500
5	23	M	BS	1330	104	1000	350
6	21	M	Aero Sc	850	120	480	180
7	22	M	Aero Sc	1000	165	700	350
8	25	M	BS	3100	110	2220	400
9	21	M	BS	440	60	170	90
10	27	M	-	1400	100	900	200
11	23	M	-	2300	190	1700	700
12	22	F	BS	1400	400	1000	600
13	23	M	BS	1100	90	800	350

APPENDIX I

INSTRUMENT DAILY PROGRESS RECORD (DPR) PERFORMANCE CURVES

This appendix presents data comparing daily performance during instrument training of the three groups (tracks) of students who completed the experiment. Data points are group means for given successive days during training. The group means are based in turn on means for individual subjects on separate measures comprising maneuvers.

The first set of curves is for average performance of groups on all maneuvers that were evaluated on the successive days. The remaining sets of curves are for the separate 13 maneuvers on the same days.

As pointed out in the section on Method in the text, and again at the end of the Results section, these data do not permit an immediate interpretation of comparative performance of the three groups, or even of a single group with itself on successive days, because of inconsistencies in maneuvers represented on separate days. The reader should refer to these two sections of the text before attempting an interpretation.

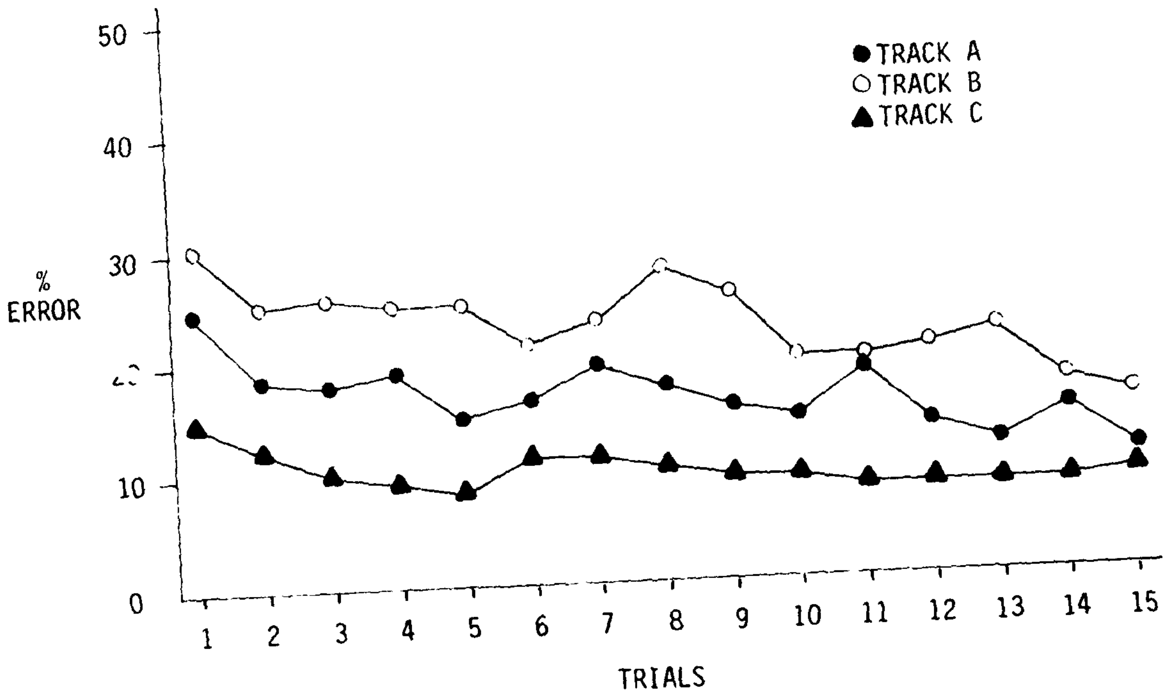

FIGURE I-1.--COMBINED MANEUVERS.

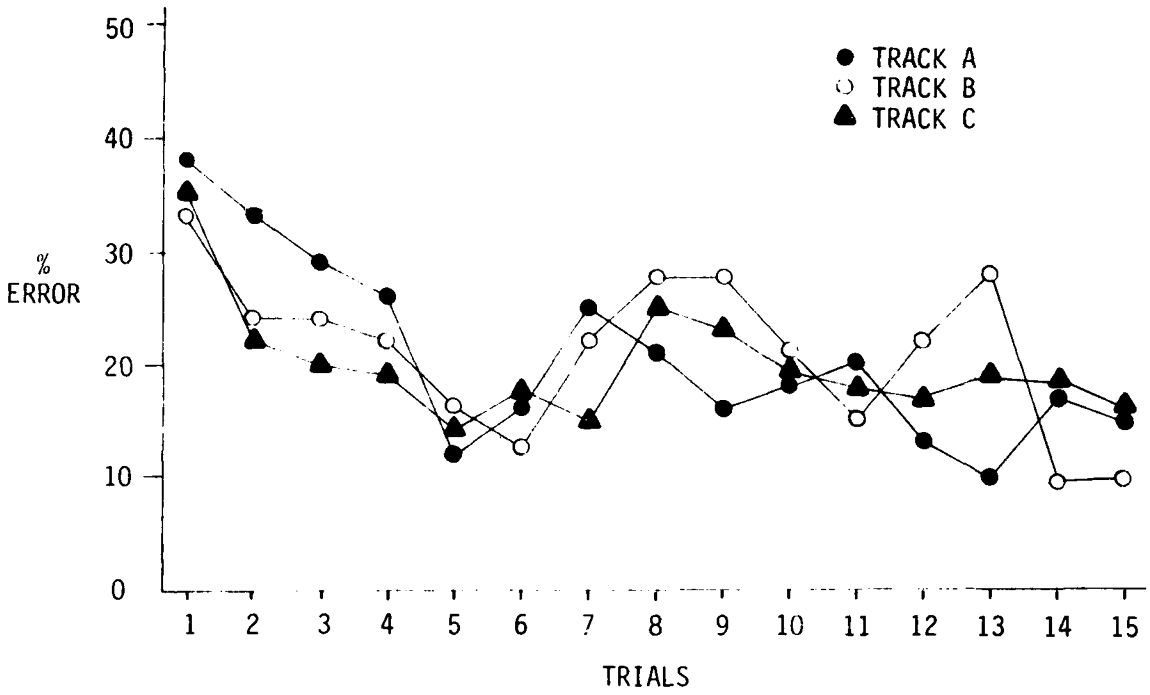

FIGURE I-2.--STRAIGHT AND LEVEL.

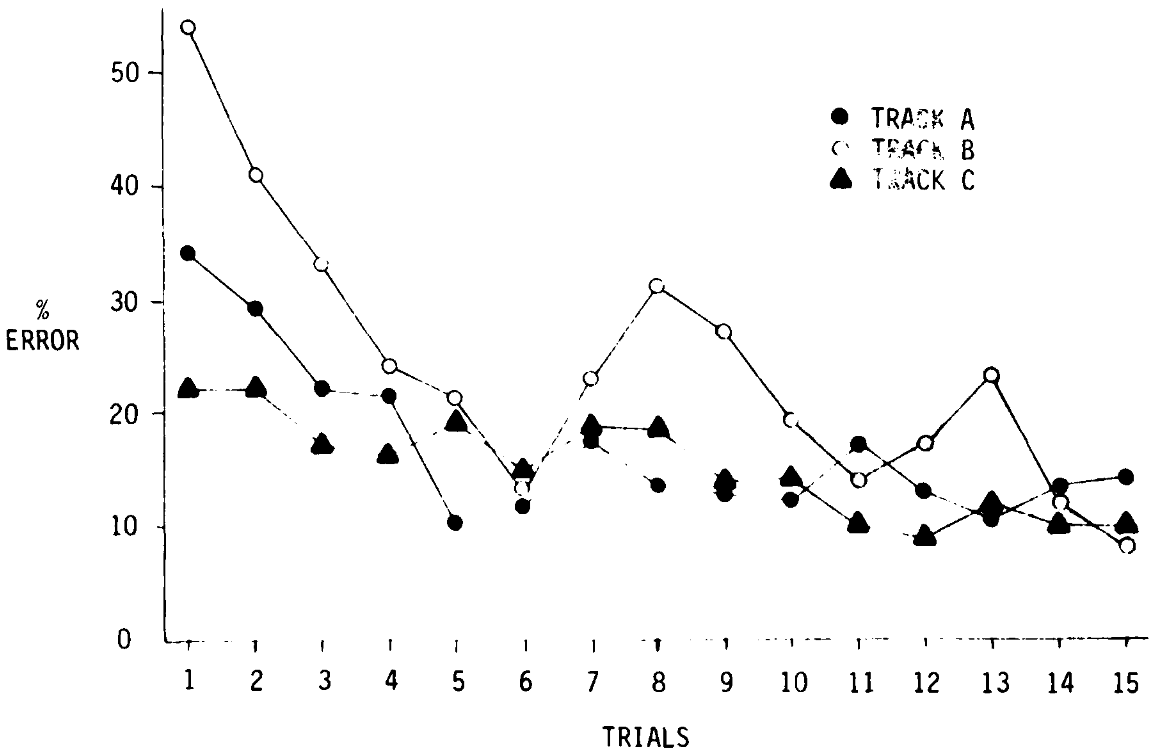

FIGURE I-3.--AIRSPEED CHANGE.

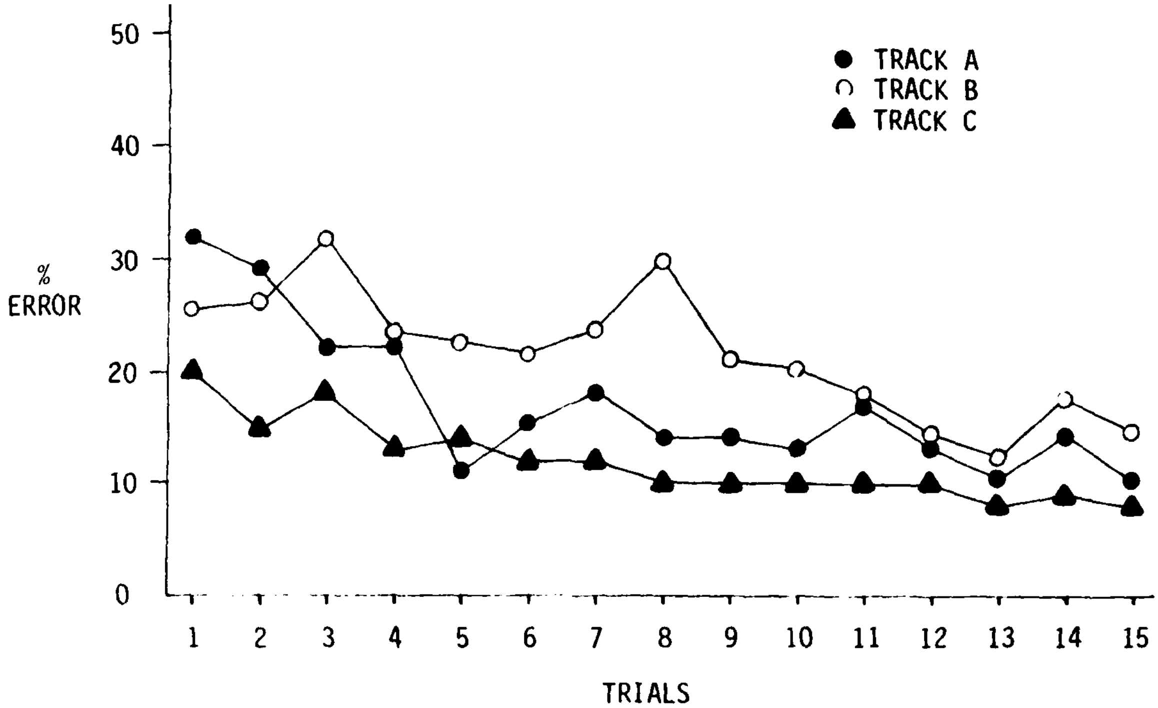

FIGURE I-4.--180° INSTRUMENT TURN.

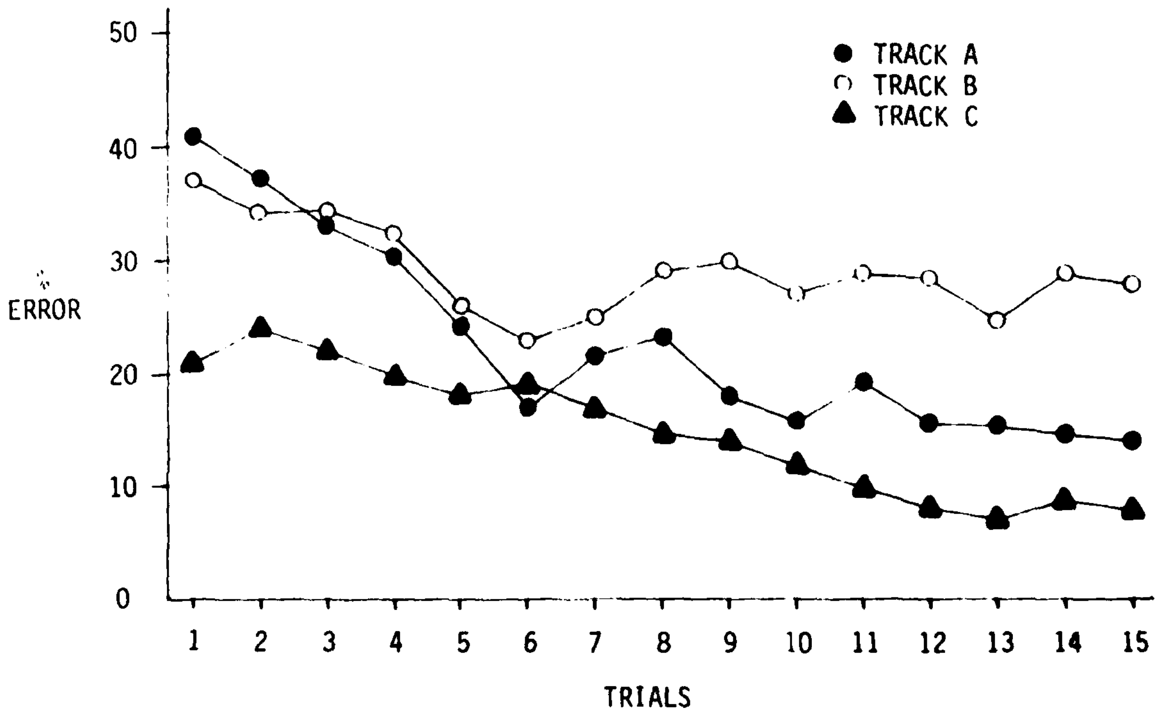

FIGURE I-5.--CLIMB/DESCENT.

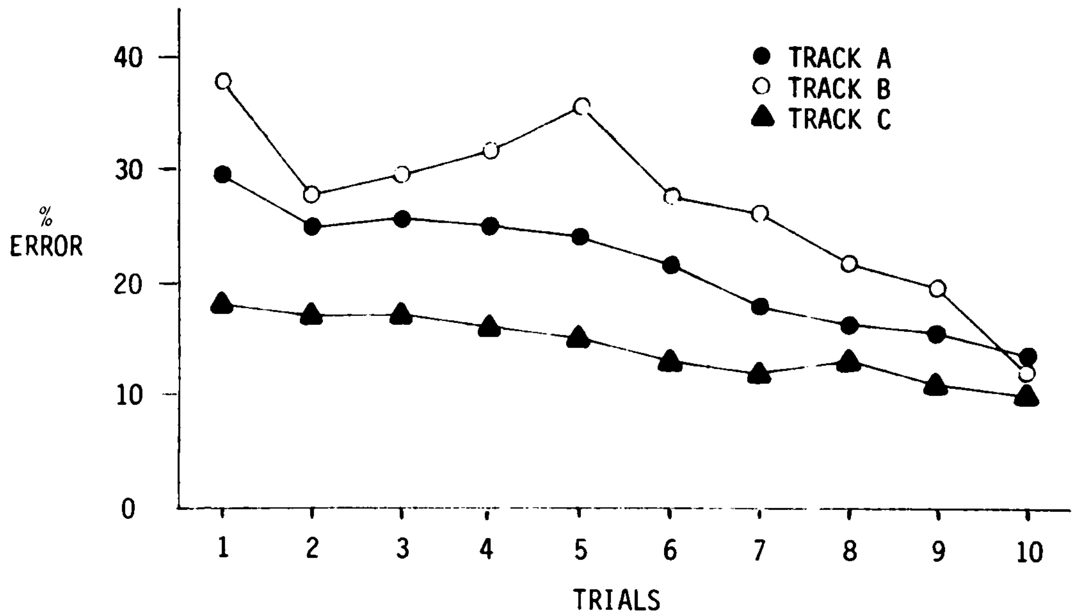

FIGURE I-6.--VOR PROCEDURES.

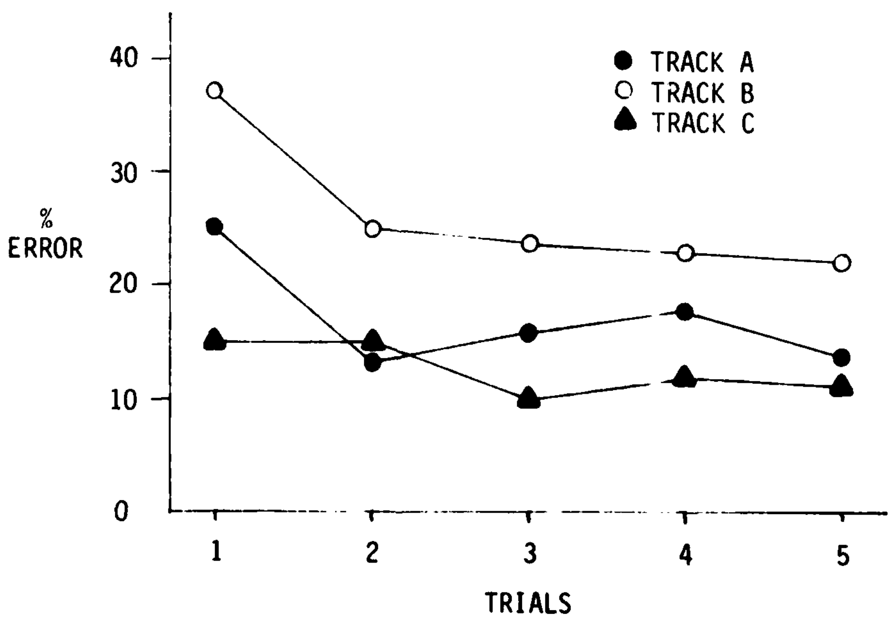

FIGURE I-7.--ADF PROCEDURES.

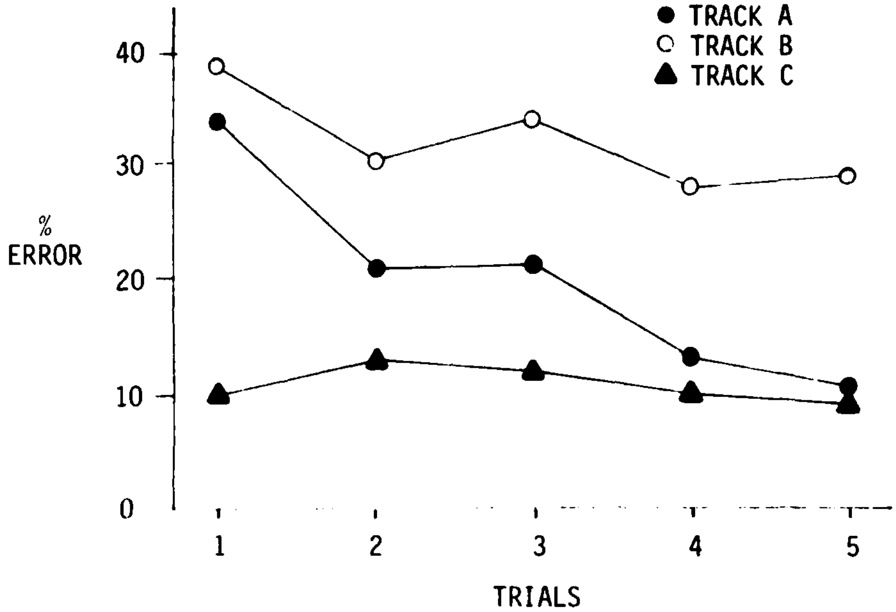

FIGURE I-8.--ILS PROCEDURES.

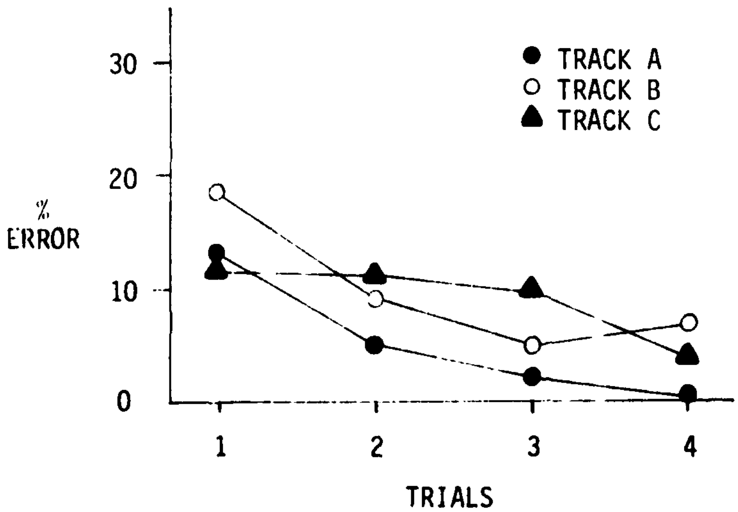

FIGURE I-9.--ILS MISSED APPROACH PROCEDURES.

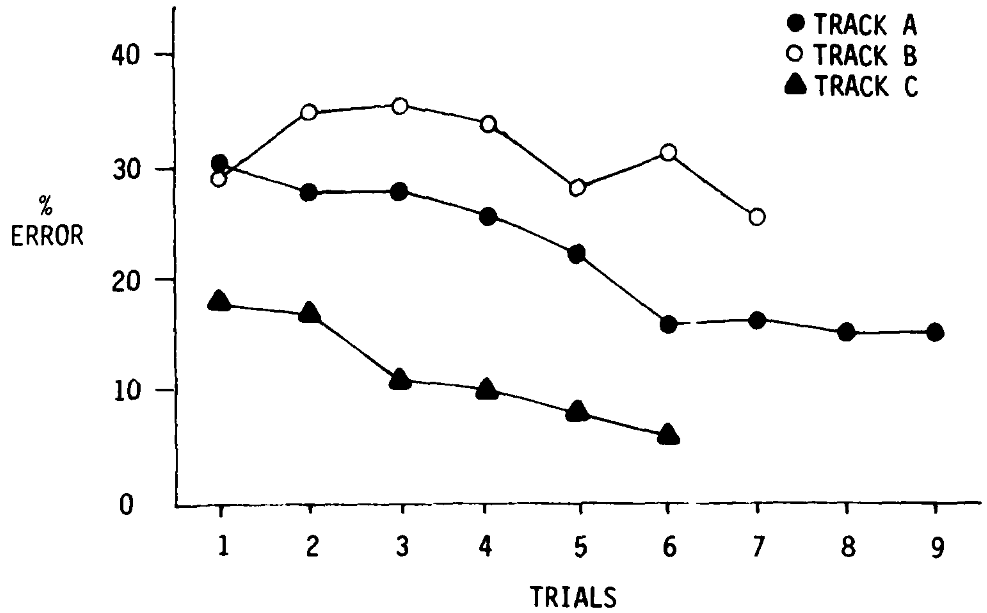

FIGURE I-10.--HOLDING.

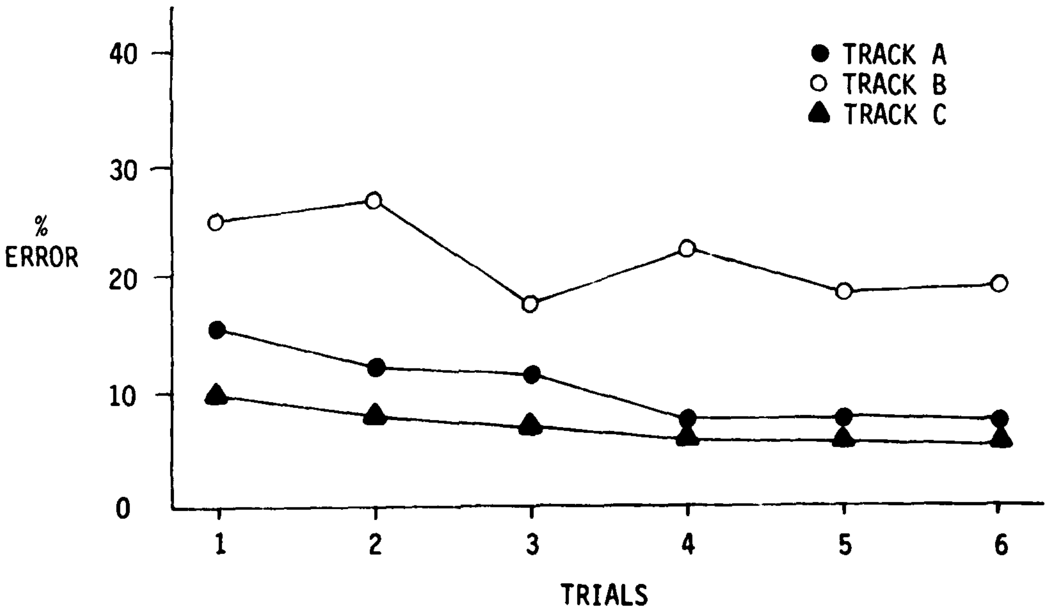

FIGURE I-11.--PROCEDURE TURN.

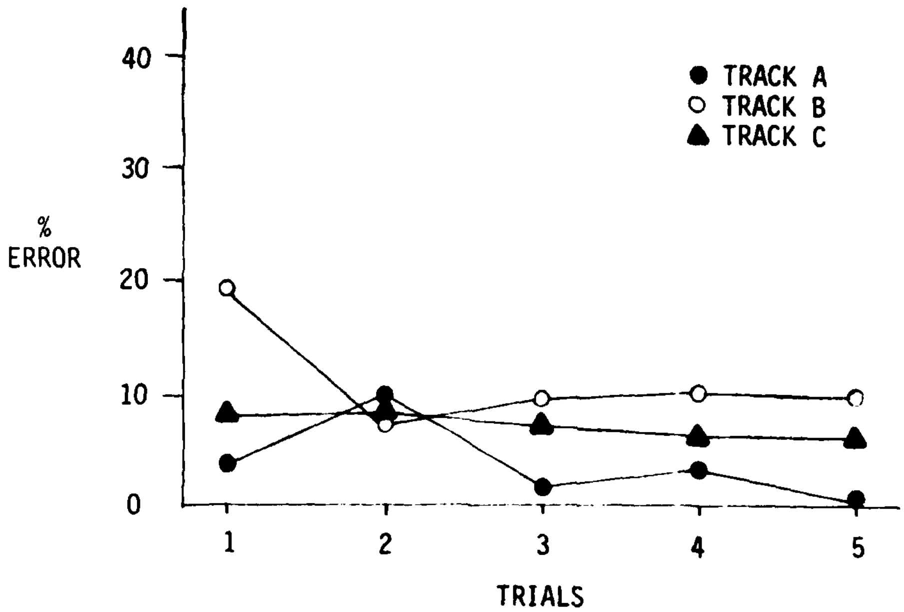

FIGURE I-12.--RADIO LOSS.

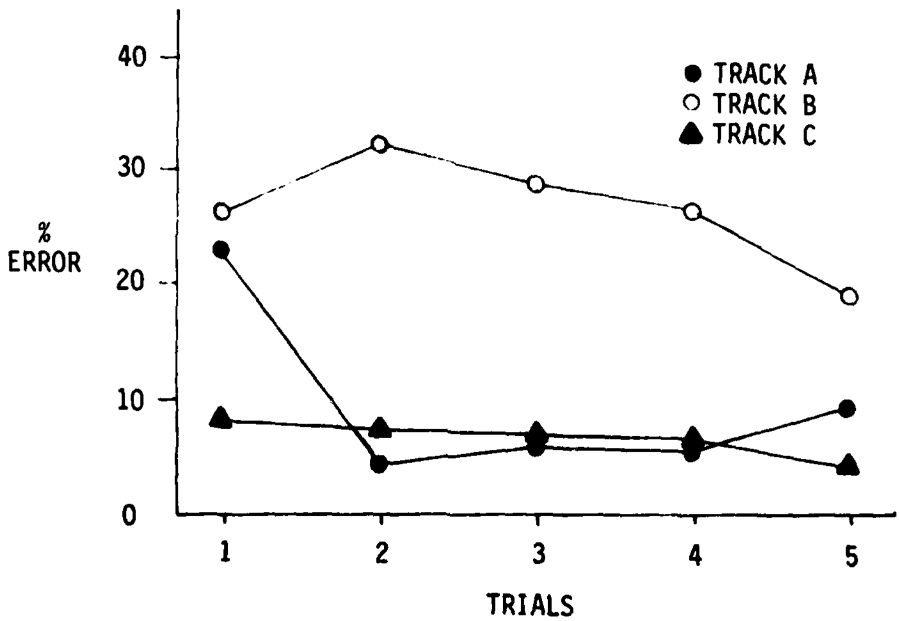

FIGURE I-13.--EQUIPMENT/INSTRUMENT MALFUNCTION.

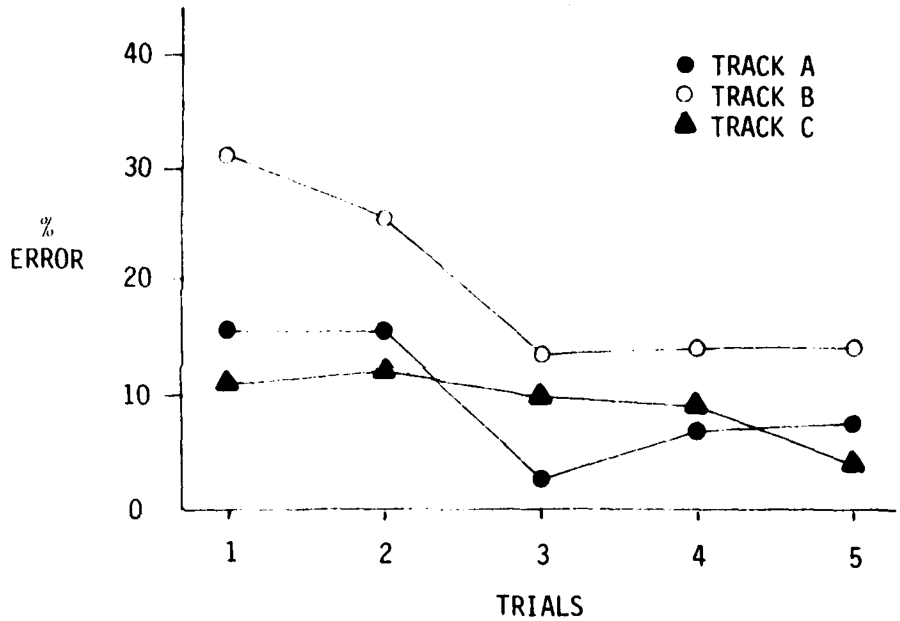

FIGURE I-14.--UNUSUAL ATTITUDE RECOVERY.

APPENDIX J

RELATIONSHIP OF PPDR ERROR AND MANEUVER LETTER GRADES

The following graphical presentations treat the PPDR percent error scores and the average maneuver letter grade scores for both the Contact and Instrument Checkrides.

The PPDR error percentage was derived by dividing the number of PPDR measures for which tolerance limits were exceeded by the total number of measures on the PPDR and multiplying by 100. Letter grades were scaled by assigning 4 points for an A grade, 3 for a B, 2 for a C, 1 for a D, and 0 for an F, then summing these values across all maneuvers performed on the checkride and dividing by that number of such maneuvers. Greater proficiency is therefore indicated by lower PPDR error percentages and by higher scaled letter grades on maneuvers.

Figure J-1 depicts mean percent error scores for each training track (A, B, and C) separately for the Contact Checkride and the Instrument Checkride. Also shown are the ± 1 standard deviation ranges about those means for each group, and the overall mean for each checkride with all groups combined (Overall Contact Mean = 21.58%; Overall Instrument Mean = 19.75%). As can be seen, Tracks A and B performed about equally well and slightly better than Track C on both checkrides. However, these differences were not statistically significant.

Figure J-2 is a presentation similar to J-1, except it shows the mean maneuver grade for each track on the two checkrides. Also shown are the ± 1 SD ranges for each group and the overall mean letter grade for each checkride for combined groups (Overall Contact Mean = 2.24; Overall Instrument Mean = 2.07). It should be noted that, in contrast to the PPDR percent error, the higher mean maneuver letter grades denote better performance than do lower grades. Again, Tracks A and B performed in highly similar fashion and somewhat better than did Track C. The differences were not statistically significant for the Contact Checkride, but those for the Instrument Checkride were significant beyond the .05 level.

The data plots in Figures J-3 through J-8 depict the overall relationship between objective (PPDR) measures and subjective assessments as represented by checkpilot-assigned letter grades for combined maneuvers on the Contact and Instrument Checkrides. Each data point represents the performance of one student. Coordinates for each data point reflect that student's overall PPDR error percentage for the checkride plotted against the mean of his scaled maneuver letter grades.

An examination of the overall pattern of data points can reveal the general nature and magnitude of correlation between the variables of interest. In the present case, the data plots show that correlations between PPDR error percentage and maneuver letter grades were negative. That is, low PPDR error percentages tended to be associated with high maneuver letter grades and vice versa. To determine the degree of this association, it is necessary to compute a correlation coefficient (r), a numerical value which ranges from -1.00 (perfect negative correlation) to +1.00 (perfect positive correlation) and represents the strength of association between sets of paired data. Higher values of r, regardless of whether they are positive or negative, correspond to greater degree of correlation between variables.

As shown in each of the data plots in Figures J-3 through J-8, the r values for the three track groups ranged between -.66 and -.78 for the contact checkride and between -.78 and -.83 for the instrument checkride. Combining the tracks into one large grouping yielded a correlation of -.71 for the Contact Checkride and -.80 for the Instrument Checkride. All of these coefficients for individual and combined tracks are statistically significant beyond the .01 level (Appendix C).

The data plots show that skilled checkride performance as judged by the checkpilots was associated with relatively low PPDR error percentages. Further, assigned letter grades indicative of less proficiency were accompanied by fairly linear increments in PPDR errors. It can be concluded that the overall relationship between objective measures and subjective assessments employed in this study was a strong one.

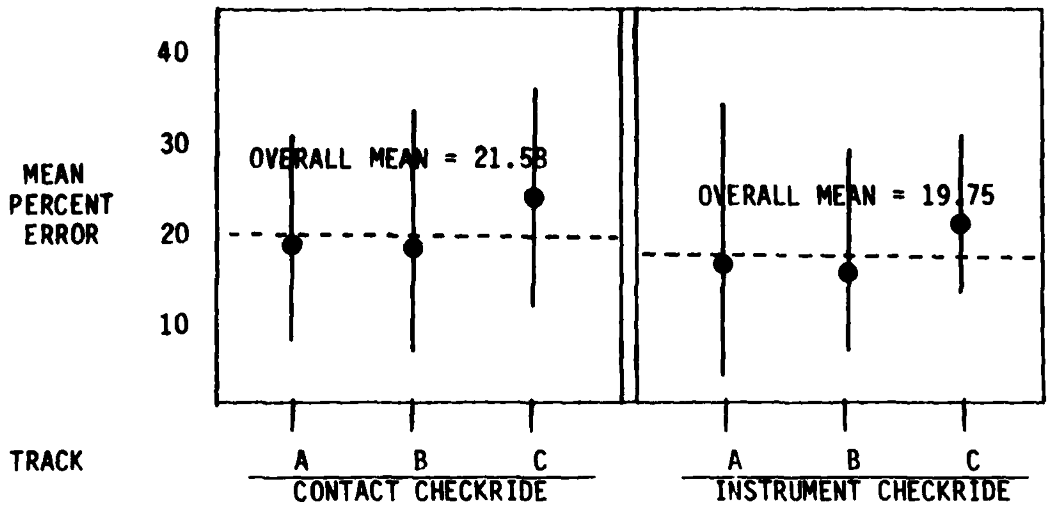

FIGURE J-1.--MEAN PERCENT ERROR ±1 SD RANGE BY TRACK FOR CONTACT AND INSTRUMENT CHECKRIDES.

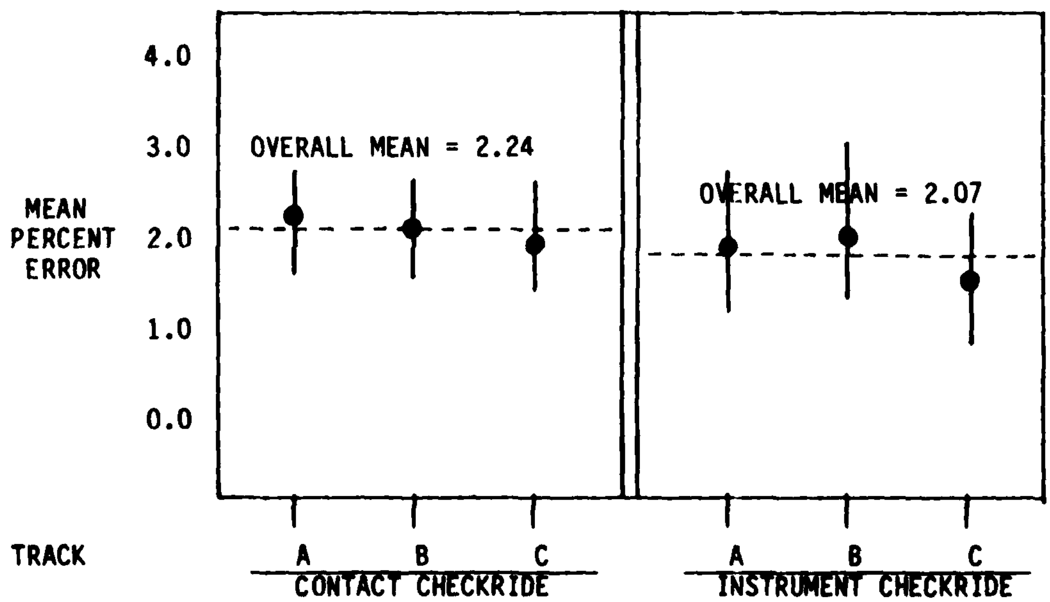

FIGURE J-2.--AVERAGE MANEUVER GRADE ±1 SD RANGE BY TRACK FOR CONTACT AND INSTRUMENT CHECKRIDES.

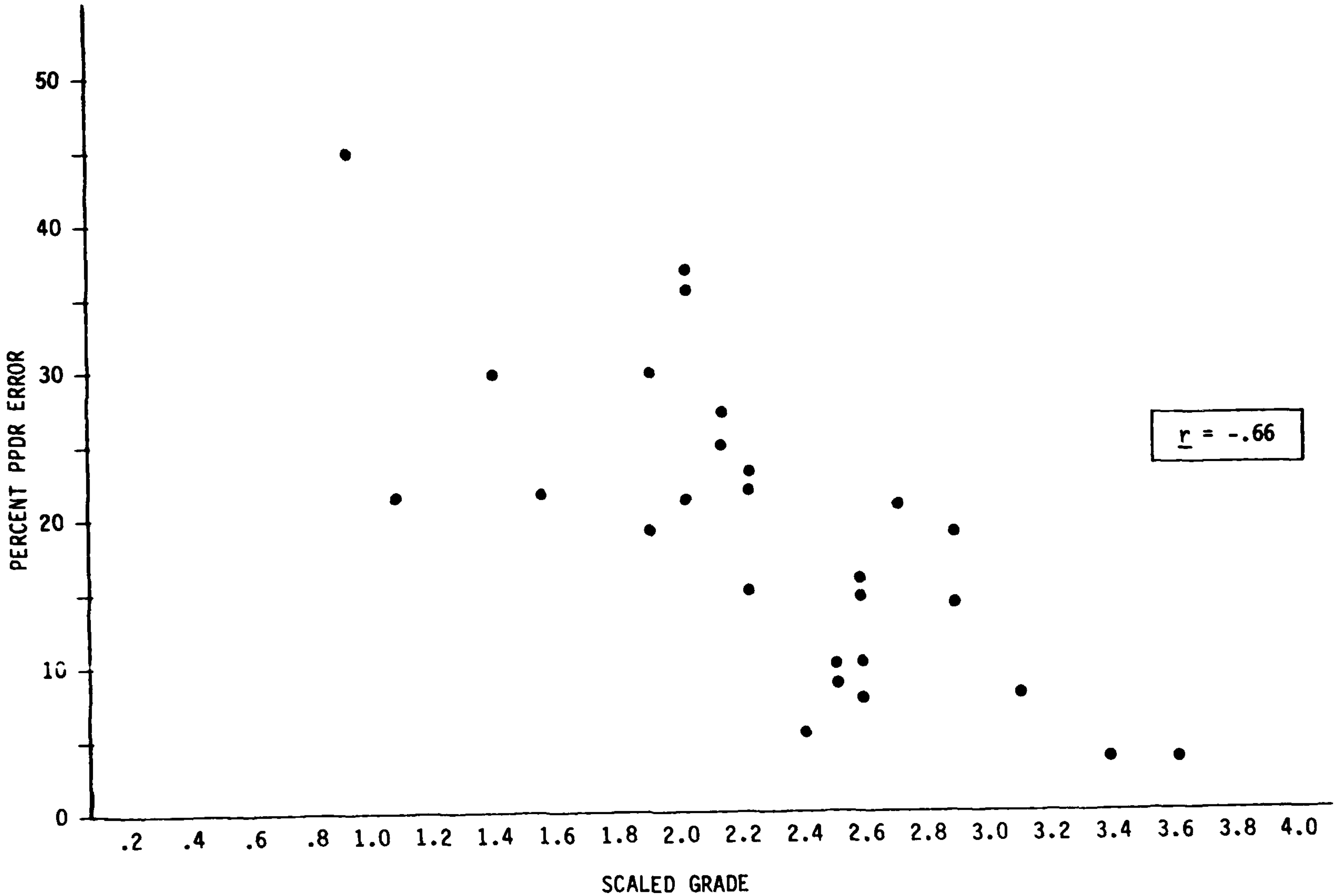

FIGURE J-3.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR CONTACT CHECKRIDE FOR TRACK A.

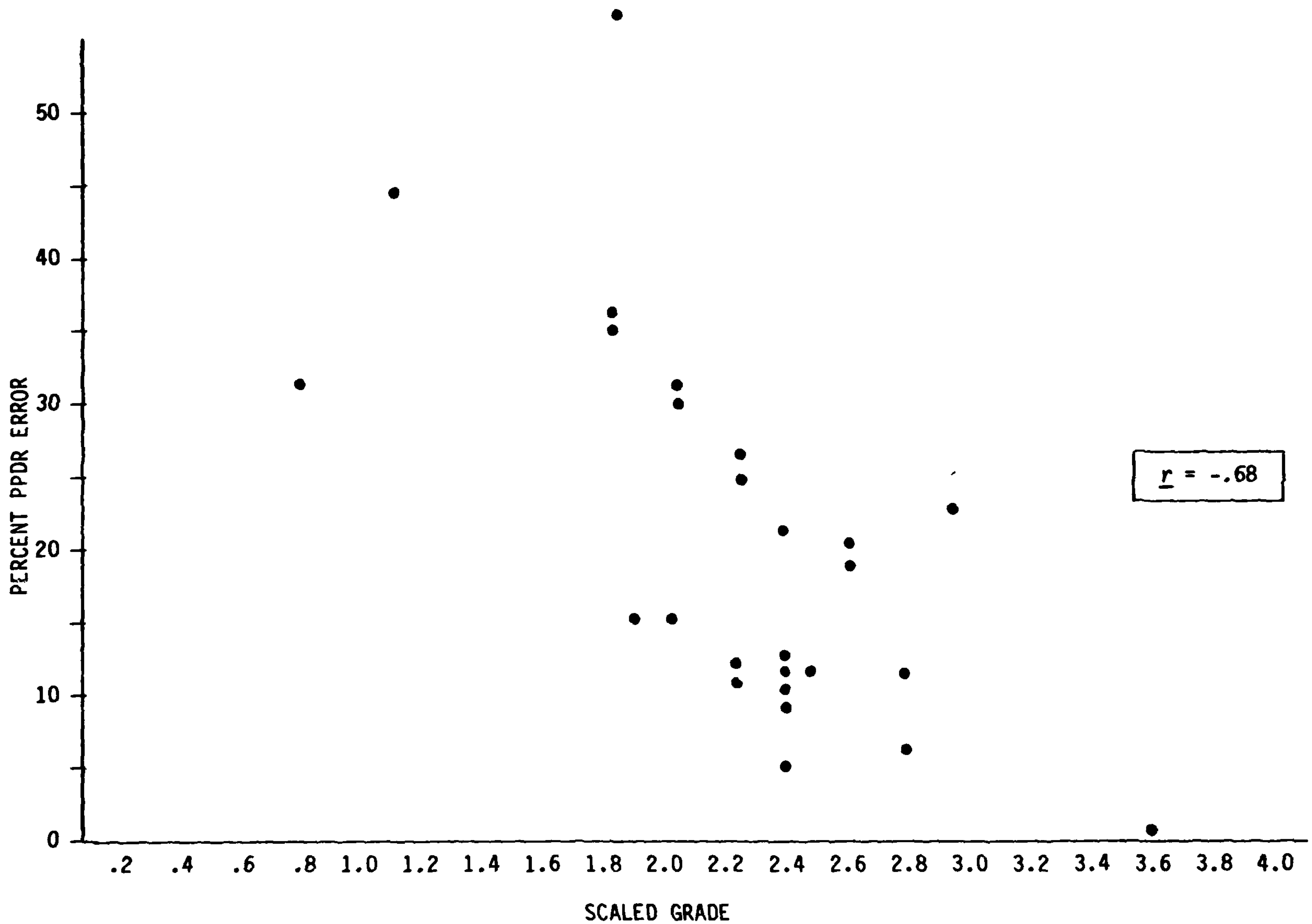

FIGURE J-4.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR CONTACT CHECKRIDE FOR TRACK B.

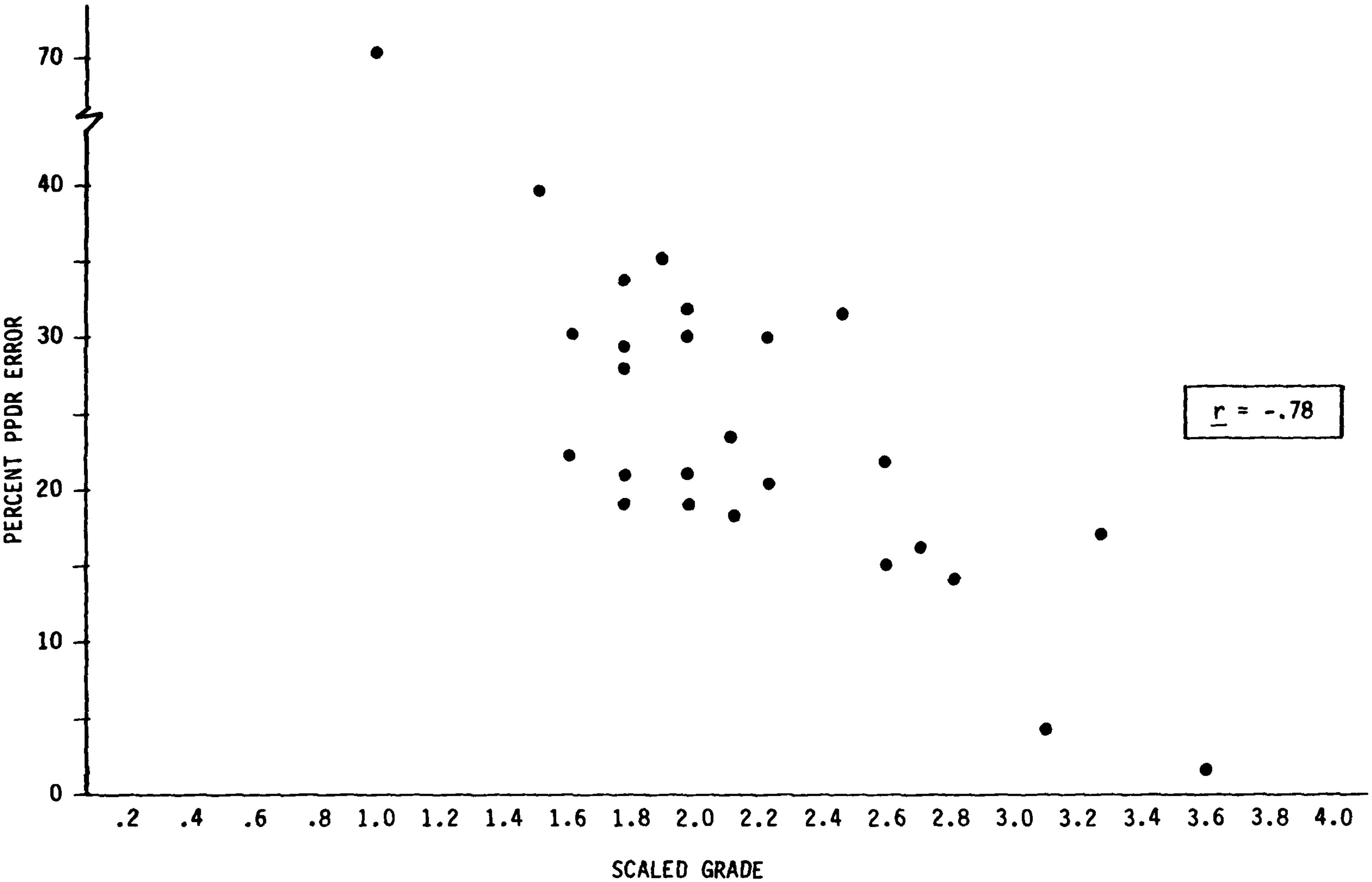

FIGURE J-5.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR CONTACT CHECKRIDE FOR TRACK C.

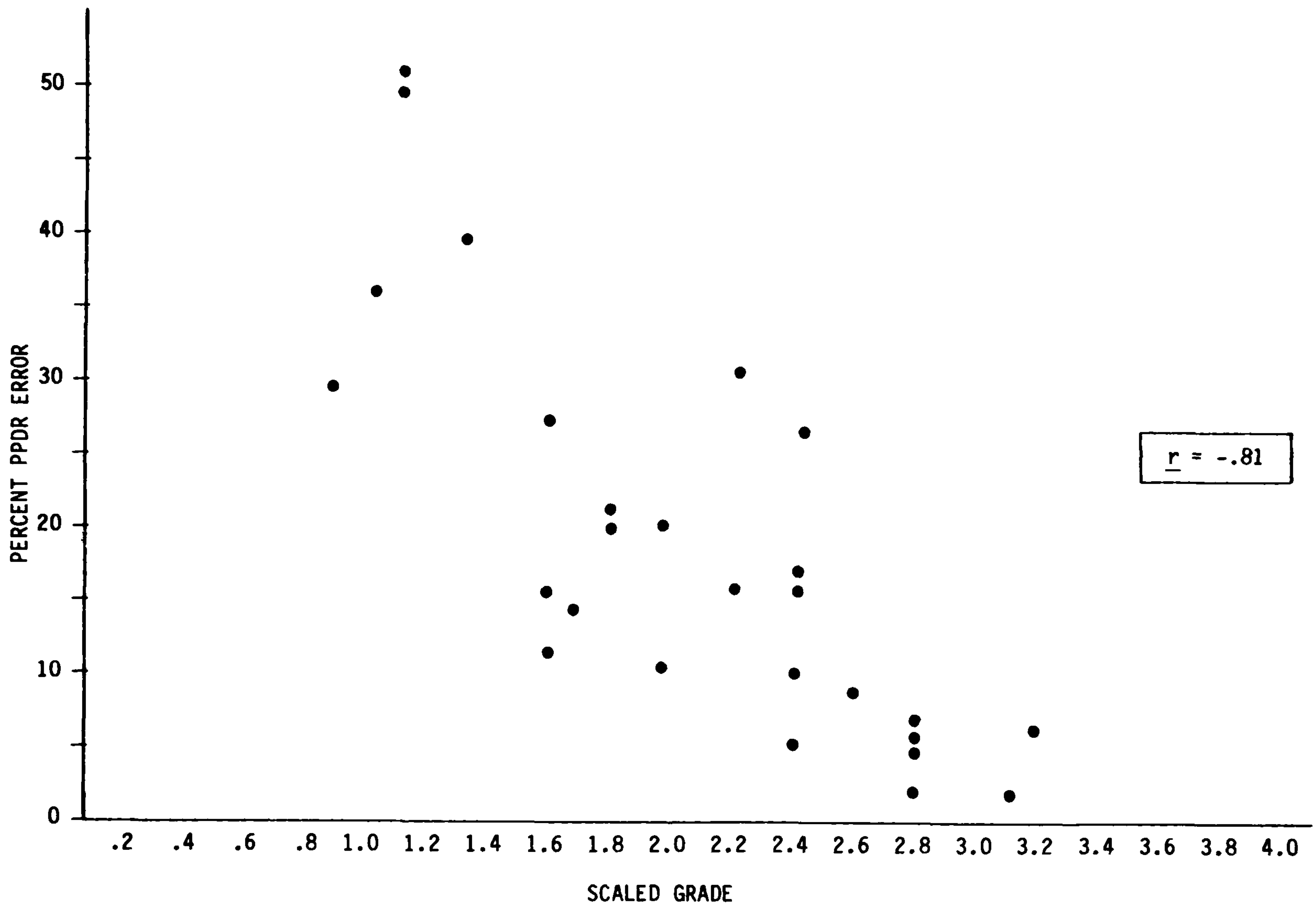

FIGURE J-6.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR INSTRUMENT CHECKRIDE FOR TRACK A.

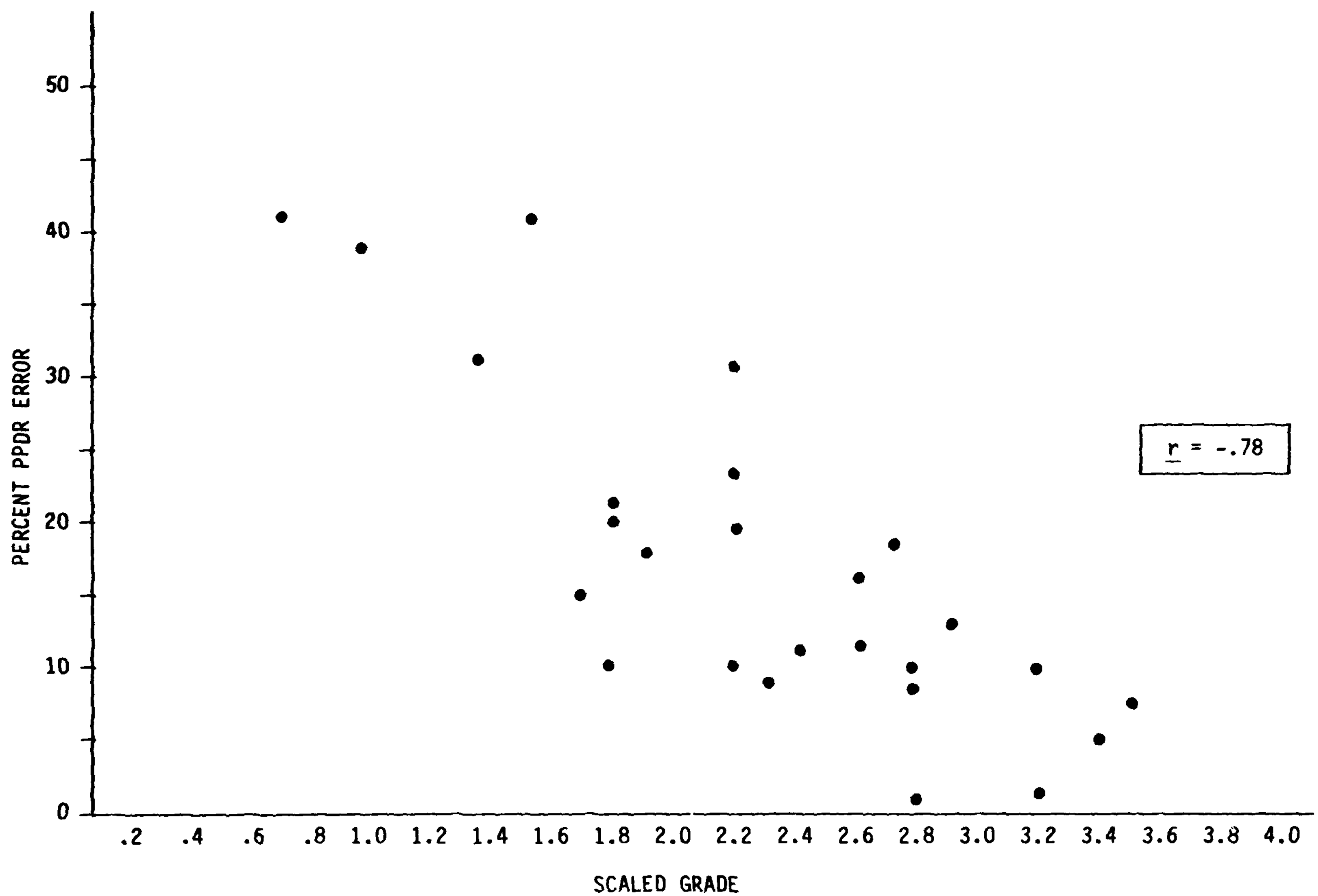

FIGURE J-7.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR INSTRUMENT CHECKRIDE FOR TRACK B.

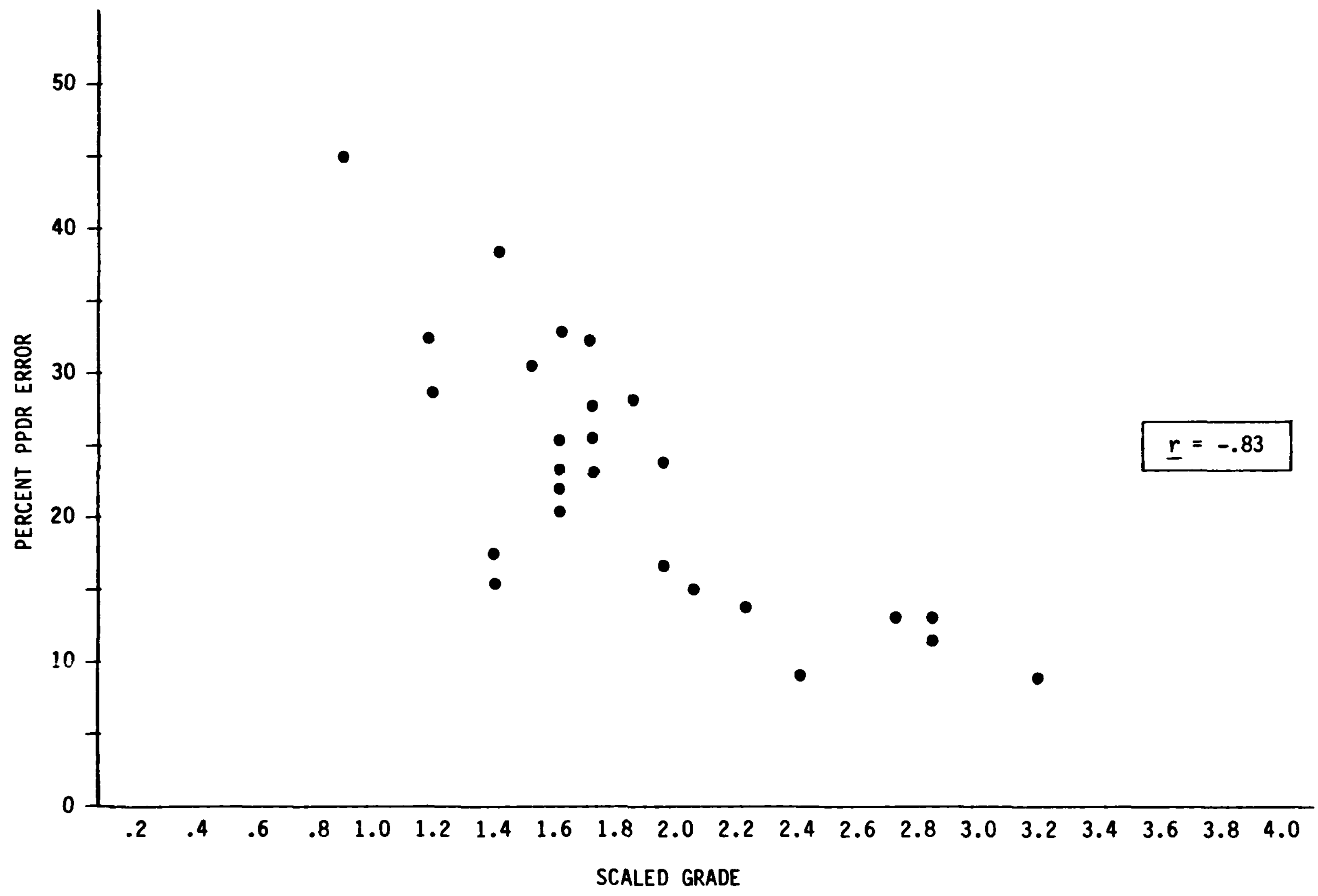

FIGURE J-8.--SCATTER DIAGRAM FOR PPDR PERCENT ERROR AND MEAN MANEUVER LETTER GRADE FOR INSTRUMENT CHECKRIDE FOR TRACK C